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Spiral Gearing.

BY O. J. BEALE.

While making some experiments with spiral gears, and constructing a model for the Brown & Sharpe Manufacturing Co., I have noted down a few points that may be of general interest.

When the teeth of a gear are cut, not in a straight path, like a spur gear, but in a helical or screw-like path, the gear is called, technically, a twisted or screw gear, but more generally, among mechanics, a spiral gear. A distinction is made between a screw gear and a twisted gear. In twisted gears the pitch surfaces roll upon each other exactly like spur gears, the axes being parallel. In screw gears there is an end movement, or slipping of the pitch surfaces upon each other, the axes not being parallel. In screw gearing the action is analogous to a screw and nut, one gear driving another by the end movement of its tooth path. This is readily seen in the case of a worm and worm-wheel, when the axes are at right angles, as the movement of wheel may then be said to be wholly due to the end movement of worm-thread. But, as we make the axes of gears more nearly parallel, they may still be screw gears, but the distinction is not so readily seen. We can have two gears, that are alike, run together, with their axes at right angles, as at *A*, *B*, Fig. 2. The same gear may be used in a train of screw gears, or in a train of twisted gears. Thus, *B*, as it relates to *A*, may be called a screw gear, but in connection with *C*, the same gear *B*, may be called a twisted gear. These distinctions are not usually made, and we call all helical or screw-like gears made on the Universal Milling Machine, *spiral gears*.

In making these gears, we devised a method that we think is new. The teeth of these gears are of the involute form, commonly called single curve. Theoretically, a rack to run with involute gears should have teeth with straight sides, as in the two racks, Fig. 1. For our system of involute gears, the sides of rack teeth incline to each other at an angle of 29 degrees, or what is the same thing, the tooth sides are at an angle of 75½ degrees with the pitch line of rack. Acting upon this principle, we arranged to plane the teeth of the three spiral gears, Fig. 2, on spiral mechanism of one of our Universal milling machines. Instead of using a rotary cutter we took a planing tool that accurately fitted the space between teeth of rack, as seen in *D D*, Fig. 1. The tool moved diagonally across the face of gear in a straight path tangent to spiral at the pitch surface, the spiral mechanism being set to the proper angle, which, in this case, was 45 degrees. The tool was set to the full depth to be cut at one operation, and the gear cut all around without changing tool. The gear was fed up to the tool by the spiral mechanism, the same as is done when using a rotary cutter. By this method each gear was an *original* one, and all sizes of spiral gears having the same pitch, can be cut with a tool of the same shape.

The rack *D D*, Fig. 1, is of regular form, the depth of teeth being $\frac{11}{16}$ of the circular pitch, nearly (P'.6866 accurately); or, what is the same thing, two diameter pitches plus $\frac{1}{10}$ of the thickness of tooth at pitch line. If a section of a tooth in either of the gears be made square across the tooth, that is a normal section, the depth of the tooth will have the same relation to the thickness of the tooth, as in the rack just named. But the teeth of the spiral gears, looking at them upon the side of the gears, are considerably thicker in proportion to their depth, see Fig. 2. The same difference is seen between the teeth of the two racks *D D* and *E E*,

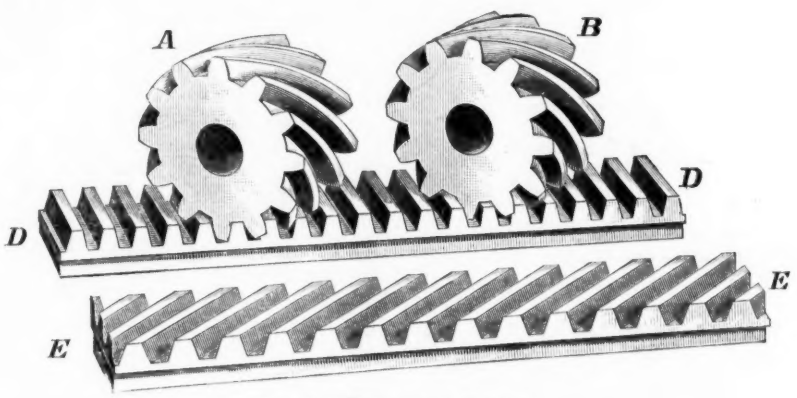


FIG. 1.—RACKS AND GEARS

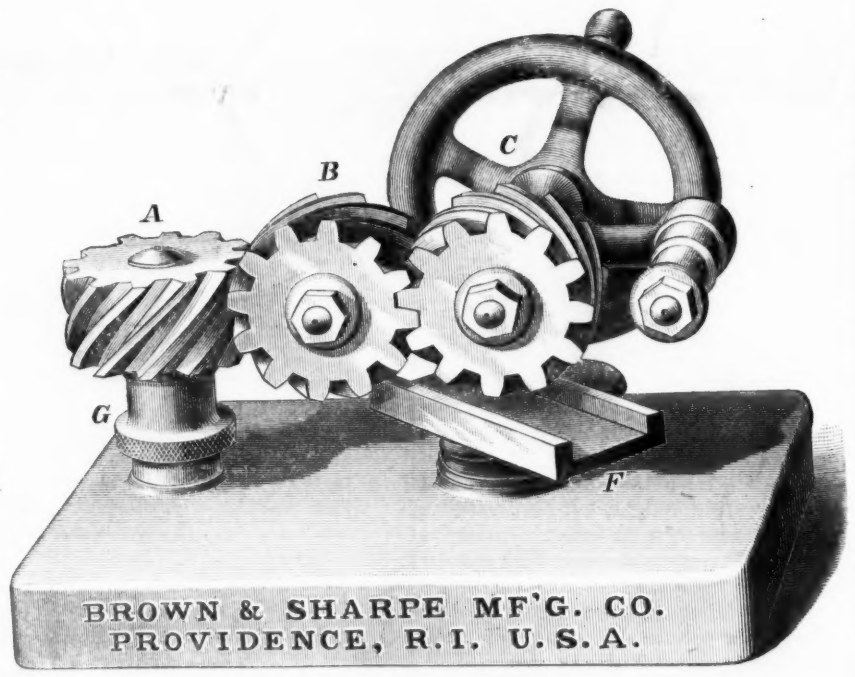


FIG. 2.—SPIRAL GEARING.

Fig. 1. Inthe rack *D D* we have 20 teeth, while in the rack *E E*, which is the same length as *D D*, we have but 14 teeth. Yet each rack will run with each of the spiral gears, but at different angles. The teeth of one rack will accurately fit the spaces of the other rack face to face, but the sides of the two racks will then be at an angle of 45 degrees with each other. The shortest distance between the centers of two contiguous teeth, or the normal distance, is called the *normal pitch*. In the gears, this distance is measured upon another spiral, perpendicular to the spiral path of the teeth. Now, in the rack *D D* the circular pitch and the normal pitch are the same, but in the rack *E E* the normal pitch line is at an angle of 45 degrees with the side of the rack.

When the normal pitch does not coincide with the circular pitch, it is less than the circular pitch. This means that a gear, say 4″ pitch diameter, 12 teeth, 3′′ diametral pitch, would not be cut with a 3″ pitch cutter. In the gears shown, the circular pitch is one inch, while the normal pitch is but .707″, or less than $\frac{3}{4}$″.

A guide for holding racks is seen at *F*. This guide can be moved to any angle with shaft *C*, up to 45 degrees. The gear *A*, Fig. 2, rests on the sleeve *G*, which is threaded so that *A* can be raised or lowered.

We have examined the two gears, *A* and *B*, to determine whether they run with equal angular velocity at all places. The gears were graduated into 216 parts, which gave, as there are 12 teeth in each gear, 18 points of observation as a gear turned through its pitch arc. By raising the threaded sleeve *G* we have another set of points for observation, because, when *B* is held stationary, and *A* is raised or lowered, *A* will turn on its axis in proportion as it is raised or lowered, thus changing the relative position of the gears *A* and *B*. Two microscopes of pretty high power were used, but no variation in the relative angular velocity of the two gears *A* and *B* was found. This proof is experimental, and not mathematical, but for practical purposes, we would accept it. It rests upon the same kind of evidence that we would have in saying that two pieces were the same size, after having found them so by measurement. Having tried a sufficient number of cases we might, by induction, establish the law that all spiral gears made upon the system described, would work together with a constant velocity ratio. We would expect that any two gears that worked correctly with a rack, made upon the system shown, would work correctly with each other. Then, if the gears ran together without backlash, we would accept them without further trial.

Gears arranged like *A* and *B*, Fig. 2, have contact in points only, and for heavy work might wear somewhat rapidly. Spiral gears also have end thrust, but, of course, no more than a worm and worm wheel of same tooth angle. Generally they have considerably less tooth angle than a worm, and hence less end thrust.

The action of spiral gears is generally very smooth and noiseless. This makes them sometimes desirable for quick-running machinery. As already implied, they can also be used for driving shafts at any angle with each other.

The angle which tooth sides makes with axis of gear is called *angle of spiral*. When two gears are both of right-hand spiral teeth or both have left-hand spiral teeth, the angle of their shafts will be equal to the sum of the angles of their spirals. But when two gears have different hand spirals, the angle of their shafts will be equal to the difference of their angles of spirals. Thus, in Fig. 2, the gears *A* and *B* both have right-hand spirals. The angle of both spirals is 45 degrees, their sum is 90 degrees, or their axes are at right angles. But *C* has a left-hand spiral of 45 degrees. Hence the difference between angle of spiral *B* and *C* is 0, or their axes are parallel. Had *A* and *B* left-hand spirals, their relative direction of rotation would be reversed. When the center distance of two shafts is variable, a greater range can be had with spiral than with spur gears. This sometimes makes them desirable for driving rolls when the widest possible range is wanted.

The end thrust on parallel shafts is sometimes avoided by combining a right and a left-hand gear on the same shaft. When the gears are cast, the two parts can be made solid. Such a combination is called "Herring-bone" gearing. In these gears the end adjustment must be accurate, so as to have both parts of the gears in action at the same time, or one shaft only need have shoulders or collars to prevent end motion. The herring-bone gears would prevent end movement of the other shaft. This kind of gear has sometimes been preferred for flour-grinding machinery.

The first power printing-press used in this country or on this continent was invented and patented by Mr. Daniel Treadwell in 1826, and was put into operation in Battery-march street in 1827. It was a bed and platen press of pretty large dimensions, the bed being capable of carrying a form a little larger than the ordinary hand presses then in use. The bed was horizontal and reciprocating. The press was constructed of very large wooden timbers about twelve inches square and a great quantity of cast and wrought iron. Connected with its huge wooden frame was a wilderness of belts, cams, pitmen, gearings and cranks. Its weight was enormous. A very strong rotating-reciprocating vertical iron shaft gave motion to its numerous and complicated parts.—*Boston Journal.*

"That Hog-Nose Drill."

BY S. W. GOODYEAR.

The reference which I find in Mr. Hobart's letter, in your issue of August 1st, to the exceptions taken by me to the application of the above name to a tool which I hold in high esteem, tends to show that, however well I described the tool, which, by the way, I have used, and have seen used in several of the States outside of Connecticut, including Massachusetts, either Mr. Hobart did not understand the description or the "hog nose drill" and the "cannon drill" are not, as he assumes, the same.

We *don't* "file back the remaining half of the drill, making it about $\frac{1}{20}''$ or $\frac{1}{16}''$ shorter than the cutting lip," except, as it is shorter than the cutting lip, in consequence of being a continuation of the same line. In our drill the entire width is a cutting lip, of which but one-half of the width cuts, the other half not requiring to be "filed back" to clear. The bottom of the hole cut by our drill is not flat, but is the highest in the center, which makes it impossible for the back half of the lip to touch the surface below the apex.

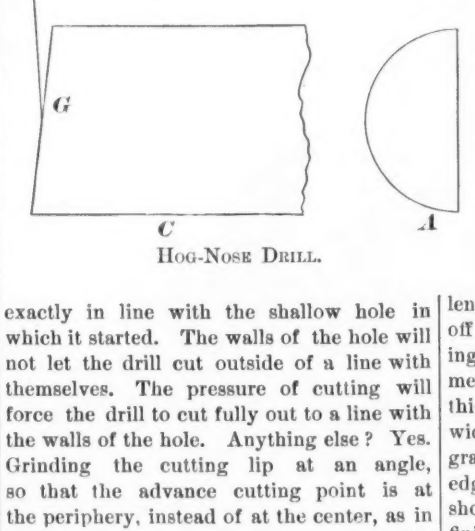
If for any purpose a perfectly flat bottom is required in a hole, then Mr. Hobart's method of making the drill would be indicated.

I once had a class of work to do in which, after drilling to a certain depth with twist drills, it was necessary to square out the bottom of the holes, and, as there were many sizes of holes to be treated in this way, I fixed the back ends of the respective twist drills, as per Mr. Hobart's description, one after another, until more than half of an entire set of the Morse Twist Drill Company's drills had "hog-nose" shank ends, if that *is* the name; but, when a drill is made in that way, there is a little mean corner just at the center which is liable to chip off, and when it needs grinding there is but little chance to grind back without fetching up on the back half, or non-cutting part, and then what would Mr. Hobart advise? Would he draw the temper and file the "remaining half" back again? He could not grind it back very well, and be sure to leave a cutting lip of just the length of one-half the diameter of the hole, could he?

In the cannon drill the back half of the lip takes care of itself. When it is advised to make the cutting lip five degrees out of a right angle with the axis of the drill, it is not necessary to be so very particular about the exact angle, and when grinding becomes necessary there is nothing required but to grind right across the entire width, and, if the temper extends back far enough, successive grindings may carry the edge back from where it was originally, an inch even, and still without any trouble about clearance. This is a drill for making holes, without reference to making the bottoms of the holes flat, and whoever will take time to analyze the principles governing the operation of the drill can but be struck by the self-evident reasons why, for many uses, there is no better tool.

Suppose a hole is wanted through the entire length of a piece of shafting, or through a roll, of from four to six feet long, and that it is highly important that the hole shall be straight, shall be concentric with the axis of the shaft or roll for its entire length. Difficult? Can't be done? Pshaw! Make a cannon drill of the size required, and enough longer than half the length of the shaft to be drilled to give room for a dog at the back end, when it has been pushed forward to do half the drilling from one end.

Between live center, or chuck, and center rest, mount the shaft to be drilled perfectly parallel with the line of the lathe spindles. To start the drill, turn in, say, $\frac{1}{2}''$ or more, depending upon the size of hole, exactly true, and exactly the right size, and with all chips or foreign matter of any kind removed, and the drill well oiled, its back center resting on the dead center after the fashion of any other chucking drill, just push it in. *If it starts true, it will go true clear up to the dog.* Why? It cannot get out of true. Why? Because the contact between the periphery of the drill and the surface of the hole in which it starts is just the same as the contact between a well-fitted journal and its bearing. The entire lateral pressure of cutting tends to keep the most constant and entire contact between the bearing side of the drill and the hole. The hole is its own rest and guide. The bearing against which the pressure of cutting comes—*i. e.*, the walls of the hole—is absolutely solid. As the drill advances, it can do nothing else but continue the hole



HOG-NOSE DRILL.

exactly in line with the shallow hole in which it started. The walls of the hole will not let the drill cut outside of a line with themselves. The pressure of cutting will force the drill to cut fully out to a line with the walls of the hole. Anything else? Yes. Grinding the cutting lip at an angle, so that the advance cutting point is at the periphery, instead of at the center, as in ordinary drills, has a tendency to force the advance cutting corner out from the center and aid the drill in clearing.

Who says, "Humph! We can drill just as deep a hole, and just as straight, with a twist drill." Let us analyze the action of the twist drill, or any other drill, with a conical point. All drills, even my favorite, do, and must, cut holes larger than themselves. The walls of the hole in process of drilling with a conical-pointed drill are only a guide for the drill within the limit of the difference between the size of the drill and the size of the hole which the drill makes, and in almost every case of drilling for any considerable depth such drills will run out. It is just as natural for them to run out as it is for the pointed pole to fall over, which the youngster tries in vain to balance and make stand upright without support. Older persons have learned that the sharp-pointed pole won't stand upright, but they continue all their lives to try to do something nearly as impossible as that which excites their ridicule when some little child tries to accomplish the feat referred to, and drilling straight holes with a pointed drill is one of them. The conical-pointed drill has a chance to run out. The provocations for running out are almost endless. Inequalities in character or condition of material, unequal jerky feeding, blow-holes or other imperfections, with divers and sundry other causes, make it reasonably certain that drills with conical points will run out.

But what is the use of my bearing on so hard about this drill which our Massachusetts friend calls "hog nose?" Of course, if that is the name, I am ready to smother my disgust, and own up to the "sweet smells," and agree to not get "grumpy about it, provided the drill gets fair play.

As to "turning the cannon drill up round, and then milling away half of it, commencing at the end, and milling out half the center, and so along until you get nearly to the shank," that depends upon the size and length of the drill. The drill may be made with a round shank, or it may be and often is made with a square or octagonal shank, by taking a piece of square or octagon steel something smaller than the hole to be drilled, and upsetting and rounding up to a size which will turn to the required size for the cutting end for a distance of a few inches, a very satisfactory tool can be cheaply made, and if the upsetting is done judiciously, there need to be no fear of injury to the steel. That the shank or body of the drill is stronger when round, and as nearly as practicable up to the full size of the hole to be drilled, is self-evident, and why there should be half of it milled, or otherwise cut away, for any greater distance back from the cutting-lip than is required to form a receptacle for as many chips as will be made at one cutting, between the removals of the drill for clearing off the chips and oiling, thereby weakening the body of the drill and adding to the tendency to spring from torsional strain, is not quite clear. Nor was it clear to me why a drill of this character, of some seven or eight feet in length, to drill a four-inch hole needed to be turned up round for its whole length, or in fact for any part of its length, and so in giving instructions for the forging of this "hog nose (?)" I directed that through the entire length, except for something less than one foot at the cutting end, the size should be made about $\frac{1}{4}''$ less than that of the hole which was to be drilled, while the cutting end was a half circle, with a projection at the extreme end on the flat side to permit of centering. In this way there was simply to center, square the ends, turn the half-round part of a few inches in length to size, after squaring the cutting-end off enough to take out the center, then cutting the flat side down till careful measurement showed that at the extreme end the thickness represented just one-half of the width, and allowing the thickness to increase gradually from a point back of the cutting edge a little, to the point where a concave shoulder was reached, joining the flattened finished part to the rough unfinished body of the drill, and by clamping to the planer-bed five degrees out of right angles with the traverse, with tool set over ten degrees, planing the cutting clearance, and the clearance for the non-cutting half of the lip at the same time, which way this last angle shall run depending upon whether the drill is to

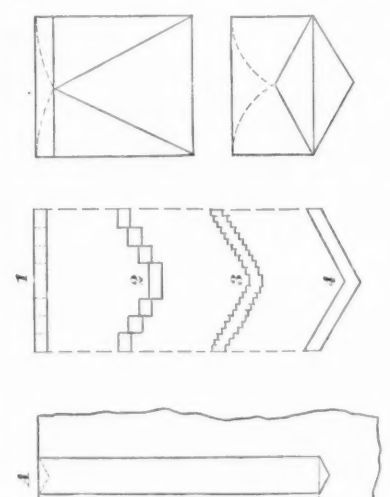


DIAGRAM ILLUSTRATING CHALK TALK.

cut right-handed or left-handed, for if right-hand taps *will* cut left-hand threads, this drill will cut *but one* way—there was quite a formidable and very effective tool made for a little money.

Of course the thousands who know all about the matter, many of them no doubt able to "give me points," are getting tired, but, if more than sixty out of every hundred don't know anything about this "proboscis," with its most insinuatingly intrusive persistence in getting to the bottom of things straightforwardly, perhaps somebody will follow me.

It is now positively asserted that Fort Worth will secure the Forth Worth and New Orleans railway. The $75,000 required will all be taken; $71,000 has been taken; the balance will be made up.—*Brenham* (Tex.) *Banner.*

Chalk Talk.

BY FRANK H. RICHARDS.

I suppose some debate could be had over the question of what is most indispensable of all machine shop appurtenances. It is probable that the grindstone would have a plurality of votes. But you can get along without a grindstone because you can always anneal a tool and file it up; while if you happen to want a piece of chalk and can't get it, what can you do? It is about the very worst fix that you can possibly put a man into. As some one has formulated it, "if you're blowed up by a locomotive there you are, but if you're blowed up by a steamship where be ye?"

Well, I could do very well without any chalk. I've tried it, and, if I dared to, I would be very much tempted to say that I would like very well to see chalk teetotally banished from the machine shop. No one need be frightened at the suggestion, because it is too decidedly revolutionary to be at all dangerous. I have not the slightest hopes of ever beholding the happy day. Still it remains true that if the extent of the use of sulphuric acid is a test of civilization the disuse of chalk is a no less accurate test of advanced machine shop practice.

I know you can do lots of things with a piece of chalk, but if you will look around you will notice that none of them are done well. It is almost hopeless to try to make a good workmen of a fellow that is handy with his chalk. Chalk is the ready instrument of unprecision and that-will-do-ativeness. The record of the Patent Office is notoriously a record not so much of invention as it is of unsuccess and disappointment, and all because inventors are too often mere chalkers. They are, as a rule, unfortunate because they deal in rough sketches, crude ideas never perfected, lacking some essential thing. The Autocrat of the Breakfast Table could keep his little poem hanging around for months, or years, until the happy moment brought a lacking verse, and made the work complete. The chalky inventor can't wait, in his haste he too often omits the one ingredient—success. Some writers for mechanical papers evidently write their articles with chalk. If they try it in the AMERICAN MACHINIST there is hope that they will be disciplined down to the type-writer before long.

Now, in what I am saying, I am just as serious as I always am. Go into a machine-shop and consider in detail the uses to which chalk is put, and see whether I know what I am talking about. Chalk is the handiest thing in the world for chucking a piece in the lathe. O yes, it is a substitute for eyesight, and only a substitute. A machinist who is to stay where he is put all his days, like any other inanimate thing, must be very careful not to do too much; he must not use his eyes, you know, because they are not hired, and so he uses chalk. There are several "machinists" in the world who are so valuable that you can only hire a little piece of them. You don't hire eyesight, judgment, memory, common-sense, sometimes not even honesty. You only hire their hands. The other day I had to ask a man if only one of his hands was hired. He was boring a piece with a chuck drill and at each half revolution of the hand-wheel the drill had to wait until the man's hand was leisurely transferred to the other side of the wheel.

It rather strikes me that Mr. P. S. Dingley, August 15, offers us a specimen of chalk work. He challenges my arithmetic, and, in effect, seems to say that it is as badly twisted as brother Hobart's. He don't know how tender is the spot he touches. I am seeking a position as Professor of Practical and Applied Arithmetic in one of our most respected educational institutions, the columns of the AMERICAN MACHINIST, and an impeachment in advance would be fatal to my claims. So it behooves me to defend myself to the extent of my ability, and brother Hobart being equally implicated, should lend a helping hand. The best way to do is to carry the war into the enemy's

country, and Mr. Dingley will please consider himself placed on the defensive.

Mr. Dingley says: "The surface cut from the time the drill is started until the base of cone is reached, should be calculated separately; also from the time the point of drill leaves the hole until it cuts entirely through." There's where the chalk work comes in. Oh, if Mr. Dingley could realize how the world admires, applauds, rewards thoroughness! How he must regret that he did not allude to the allowance to be made for the center-punch hole where the drill starts, and for the rag that tears off and is not cut when the drill come through. These are certainly important deductions to be made. And then Mr. Dingley must regret that he did not look a little farther back over our "twisted arithmetic" and see that in his last paragraph he is talking about something that we have nothing to do with. I was not computing the performance of a drill in cutting through a piece 12″ thick, but in drilling 12″ deep and cutting at its best for the whole distance. To save Mr. Dingley, or anybody else, from looking back over the files, you can see by this cut *A* what we were trying to compute.

Again Mr. Dingley says—and herein I suppose is the principal twist: "They have calculated the surface cut by the drill, as if the drill were flat on the end instead of cone shaped, which makes a very material difference." Does it? Please to cast your eye over the central diagram. No. 1 is a chip cut with a flat-ended drill. A pretty thick chip, but no matter for that; we can see it better, and talk about it better on that account. No. 2 is a chip of the same thickness made into a series of overlapping connected concentric rings. No. 3 is a chip of the same thickness formed of a greater number of these rings or steps. No. 4 consists of an infinite number of steps. Whichever shape of drill is employed, with a certain feed the same number of revolutions of the drill will remove the same quantity of material. But I must confess that this is not ingenuous. Mr. Dingley is right; the conical surface is of course greater than the flat surface. I might say that I followed Mr. Hobart's lead in the matter, that I corrected his solution of the problem and not his statement of it; but that, I suppose, would be ungenerous. So there seems to be no way out of it but for me to figure the conical surface cut by the drill. Now, if I were cast ashore on a desert island, and the chest with my Haswell and Nystrom and Trautwine, and all the other big heads, not yet recovered, what would I do about it? I should sit down and think it over. I would be very likely to think of the common expedient of measuring something else first. To measure the surface of a circle, we always measure the surface of an outside square first, and then take a certain part of it. That's what the .7854 does. So to measure the surface of a cone, I imagine the cone placed in a cylinder that will just hold it. I have to use a hollow cylinder, or some steam-engine man will get mixed on it, but hollowness has nothing to do with a cylinder, which is simply anything round, of any length. Take a round stick of candy, or a round lozenge, one is as truly a cylinder as the other.

Now, we know that to cover the curved surface of the cylinder inside or out, allowing nothing for thickness of material, we would require a piece equal in width to the height of the cylinder, and long enough to reach around it. The surface of the cylinder, not including the ends, would be equal to the product of the height by the circumference. Now, if we look at the cone that we have in the cylinder, with a view to covering it or computing its surface, we see that if we take the material with which we have covered the cylinder, to cover our cone with it, we shall have more than we want, because, beginning at the bottom, it takes exactly the same to go around the cone that it does to go around the cylinder, but as soon as we begin to go up the cone it gets smaller all the way up, while the cylinder measures the same as at the bottom. At the base of the cone we take the whole length of the stuff required to go around the cylinder, at the point of the cone we take nothing. Consequently there is left the whole length at the top and nothing at bottom. We have just as much left as we have used, and could cover another cone of the same size with it. Let us say then, it takes just half as much to cover a cone that it does to cover a cylinder of the same base and height. But, hold on, hold on! We've been going a little too fast. The side of the cone is slanting, and the side of the cylinder is vertical. The side of the cone is longer, as a slanting line always is. We know of a man that when his walk is "slanting" he does not get home by the shortest cut. If then we want to use the cylinder as the measure of the cone, we must have a cylinder whose side will be equal not to the vertical but to the slant height of the cone, and the surface of a cone, according to the books, the convex surface they say when you stand on the outside—is the product of the circumference of the base and one-half the slant height.

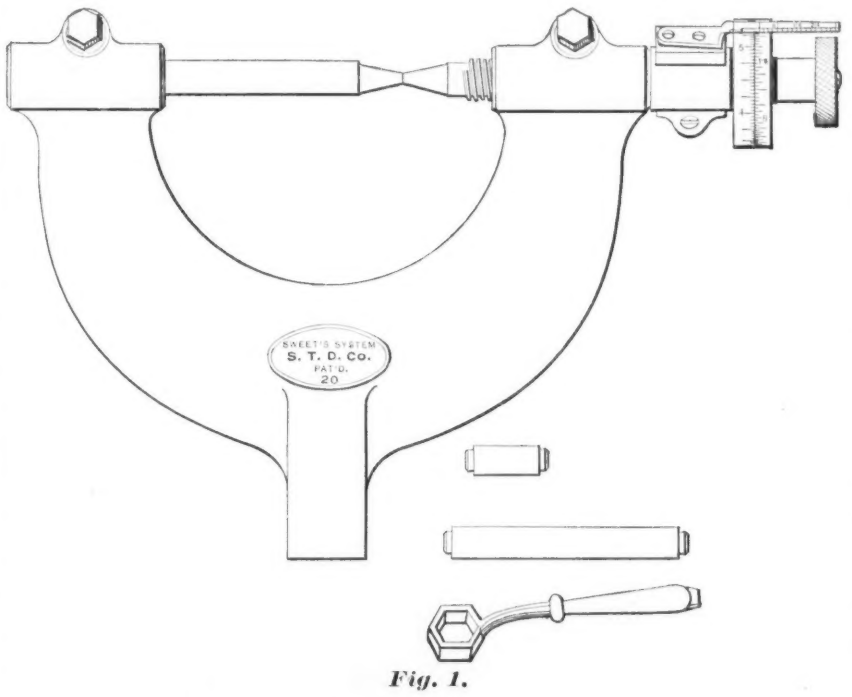


Fig. 1.

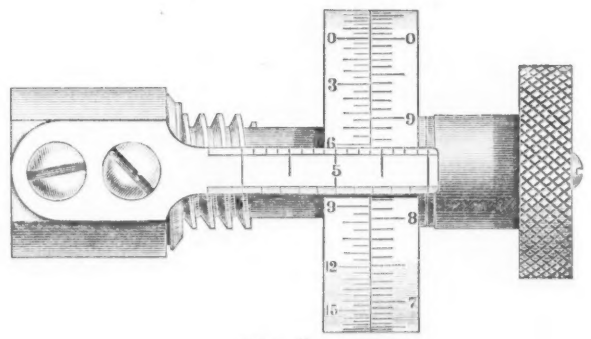


Fig. 2.

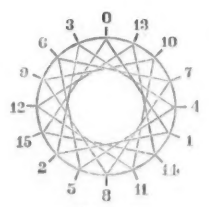


Fig. 3.

I have talked of taking enough to cover the cone out of what we cover the cylinder with and of having one half left. There would be stock enough to do it, but we couldn't cut out the material the right shape to go on smoothly. The cylinder envelope would have to be cut by a series of wedges, long and narrow, the height of the wedges equal to the height of the cylinder, and every other wedge-shaped piece taken. An infinite number of these alternate pieces accurately laid would cover the cone exactly.

The height of the cone makes no difference. A rule for measuring it will measure it with equal accuracy, whether a mile high or an inch high, in fact, will measure it just as well if it have no height at all. Change the wording of our rule, and we have the measure for the surface or area of a circle. When the cone has gradually sunk until it has lost all its height, and is simply round and flat, it is a circle and the area of a circle is the product of the circumference and one half the radius or slant height with the slant all slanted off.

And now we are ready to compute the conical surface cut by an average drill. A twist drill cuts a truncated cone, and that's the worst kind, and as our chalk has given out, our work must fare the fate of other chalk work, and go unfinished for the present.

Improved Measuring Machine.

We illustrate an improved form of Prof. Sweet's measuring machine, the original of which is already known to our readers. Fig. 1 is an outline view of the instrument, and Fig. 2 is a full-sized view, looking down upon the index-bar and graduated circle of the new style.

The pitch of the measuring screw is $\frac{1}{10}$″, securing a much quicker adjustment than heretofore. The circle is divided into 100 parts upon the right of the central or reading line, each division thus representing .001. Every tenth mark is stamped with the digits, reading hundredths. The front, or lower side of the index-bar, is divided into tenths, corresponding with the threads of the screw. As shown in the cut, the reading is as follows: The reading line is beyond the *sixth* division of the bar; the nearest figure is *eight*, and there are *two*, and, say *two-tenths* spaces between the figure and the bar. Putting these figures together, we have .6822 *without any calculation.*

In graduating a scale to read by 32ds, it is to be noted that 10, the number of threads to the inch, is composed of the factors 2 and 5, the latter of which must be eliminated, as it is not contained in 32. To accomplish this the scale is made to read five times around the circle, covering five turns of the screw, or a half inch. Beyond the half-inch point the reading begins anew. A half-inch is sixteen-thirty-seconds, and the scale reads as shown in Fig. 3. Following the line of chords from zero to the right, the numbers will be found in progressive order, every fifth being counted, and coming back to zero after five circuits. A portion of the scale to the left of zero is seen in Fig. 2, upon the left of the reading line. This would be somewhat confusing, if it were not for the graduation by sixteenths upon the back side of the index-bar. The odd thirty-seconds are easily supplied by estimation. This is intended simply as a finder. In the figure, the reading line is very near the eleven-sixteenths mark, or six-thirty-seconds beyond the half-inch. By turning the disk to this mark, the figure 6 is brought into view, and is seen just behind the bar. When it is brought to the front edge of the bar the measurement is exact, and this again *without any calculation.* It is doubted if this has ever been accomplished before, to make the same measuring screw read by thousandths and thirty-seconds without "working it out" or consulting a table.

Differences above or below any 32d may be measured by the left-hand scale, one space of which is $\frac{1}{1280}$, and 5 spaces $\frac{1}{256}$, or $\frac{1}{4}$ of $\frac{1}{64}$; or in thousandths by reading the spaces at the right of the line. Thus, in the figure the reading is $\frac{11}{16}$ *less* .005. In reading 64ths and half 64ths it is to be remembered that it requires five spaces to count one.

In this instrument all the important features of the former one are preserved, viz.: the ratchet thread having a nut the same length as the screw, the plain tail-spindle adjusted by distance-pieces, the index-bar adjusted for each individual screw, and set in any position desired by the operator, and the improved friction sleeve. A similar machine with a 20-thread screw is also made.

This instrument is manufactured by the Syracuse Twist Drill Company, Syracuse, N. Y., in sizes of four and six-inch capacity.

Steel Castings on Pacific Railroads.

Since publishing the letters from twenty-five railroads two weeks ago on their experience with steel castings, we have received the following letter from the general master mechanic of the Southern Pacific Company, operating 4,710 miles of railroad:

"We have used steel castings, more or less, for the past fourteen years, principally in rocker shafts, crossheads and pistons. Where used for crossheads upon wrought-iron guides, a phosphor-bronze or gun-metal gib is required. A crosshead of steel can be made one-half the weight of cast iron, and we have not yet had one break. Pistons are made just about one-half the weight of cast iron. None have ever broken, except upon an engine giving way in some other part—breaking a crank-pin, rod strap or something of that sort. With the rocker shaft we have never had any trouble. They do not wear fast—not nearly so rapidly as wrought iron—and are made somewhat lighter, except in the bearings, which are made about as large as we would make them of wrought iron. In my opinion, where steel castings can be used, they are very much to be preferred, for the reason that they can be made one-half the weight of cast iron, and are very much stronger. A. J. STEVENS,
General Master Mechanic."

A Lowell paper says that the Appleton Mills of that city, although paying their help but once a month, have for several years given many of them the privilege of drawing their wages weekly. Lately the facilities for getting their wages every week have been simplified by furnishing all the overseers printed blanks, upon which they can make out orders for employes' pay. The first week after the change 150 of the 850 employes drew their pay. Probably most of the hands consider the weekly payment a special favor which they hesitate to ask. A weekly system of payments is greatly to be desired in every manufactory; but where the rule is to pay but once a month, employes should be privileged to draw at least a portion of their pay every week, if they need it for immediate use. No workman should be forced to run into debt while he is earning enough to pay his way.

The *National Gazette*, of England, says that China has contracted with a Manchester firm for materials for the construction of a railway from Takou, on the Yellow Sea, to Tonchow, on the Pei-Ho—a point about twenty miles east of Pekin. The railroad will be a most important work, will be about 100 miles long, and will give Pekin a direct and easy communication with the Yellow Sea. The road is to be built and operated by the Manchester firm with Chinese labor and capital. China is raising in Europe a loan of 100,000,000 florins, to be expended in internal improvements.

Hicks' Clingstone Fruit-Pitting Machine.

This machine, as here illustrated, is for removing the pits from Clingstone peaches, but will be made for all kinds of Clingstone fruit.

The engraving shows the machine with a peach in it ready for being operated upon. The action of the machine will be understood from an inspection of the engraving. It will do the work of several hands, and in a superior manner. It has handy means of adjustment for different sizes of fruit.

The machine is manufactured by the Brady Manufacturing Co., Brooklyn, N. Y., who have prepared the necessary tools for manufacturing on the interchangeable plan, so that parts that become worn or broken can be ordered by the letters on the engraving, with the assurance that they will be perfect duplicates in all respects.

How to Learn.—Trussing a File.—Cotton Waste and Steam Pumps.

BY JAMES F. HOBART.

What a mechanic needs most to-day, is to know how to think. A man who can do this is never at fault for ways or means. He can meet any emergency. If a difficult job comes along, he rises to it and enjoys conquering the difficulty. He is an inventor. He invents hundreds of things every month of his life.

Such a man loves dearly to go on a tramp. He loves to go into every shop and factory and use his eyes. That man is a scholar. He is at school all the time. He has learned the one vital lesson and knowledge is his. Our man has learned how to learn.

Not a shop does our man enter, but something appears which he wished to see. He learns a new kink while he is watching Bob light his pipe or set a lathe tool. He finds a treasure where Mike would see nothing but steel, scrap iron and $2.00 a day.

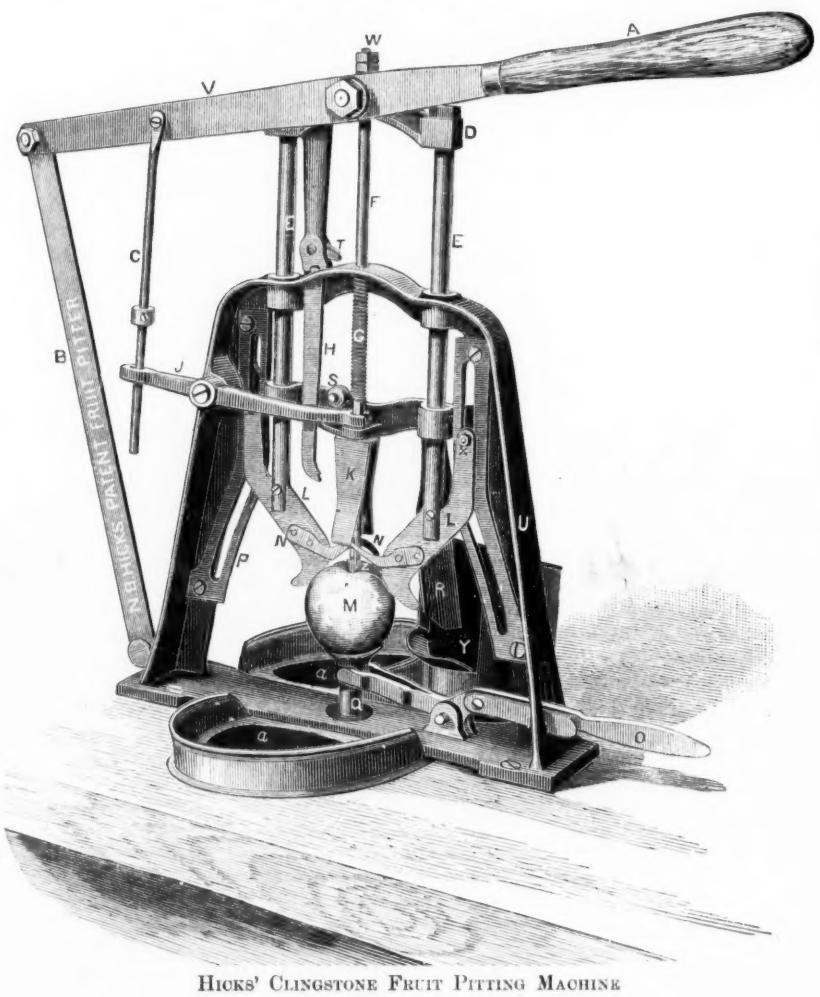
Perhaps our man has got half an idea as to some improvement to a machine. He is working up his odd minutes in perfecting his invention. As he walks through Dozer's shop, he sees a jig for some peculiar job. It is nothing but a couple of screws and two pieces of iron, yet it suggests something to our man, and his invention is perfected. Like a flash, the mind catches the idea of what is wanted, yet the article which suggested it is no more like it than "elbow grease" is like "taper oil."

When you learn a trade, or study a lesson, then learn how to think and how to catch new ideas. Learn this thing, and if you can do it the trade is yours.

Our old friend Tom, of tool-grinding fame, has quit the old shop. They have thrown away the old wooden-frame grindstone, and put in a "high-pressure, non-condensing, automatic" concern, which a dude would fall in love with.

This dandy grindstone is hung in a cast iron case which looks like a cheese box set up on edge. A grindstone truing device sets on top of the case. The stone slides up to the dresser on a kind of a screw carriage, like the crosshead of a planer; just in front of the dresser is a hole in the case; said hole is 4″ wide. Turning a hand-wheel turns the two screws and raises that stone clean up to the dresser, and within $\frac{1}{16}$″ of the iron case. The men all grind in that little 4″ hole in the iron case. Tom can't get to the back of the stone, or the front either. He must grind right in that hole and there is no chance of drawing the tool down unless the tool is less than $\frac{1}{16}$″ thick. They have rigged up a nice emery wheel right beside the dandy grindstone, and the boys all used it to rough down a tool on the emery wheel, and then finish it up on the grindstone. Some of the boys, and Tom among them, got so used to the emery that they used to finish up there, as well as do the rough grinding.

One day we saw Tom filing up some large work. He had an 18″ file, and was growling because it was crooked. Straight files are scarce around here, and Tom's was no exception. It was "bowing" on one side, and "hollow" on the other. Tom had used the crowning side until it had got tired, then he looked longingly at the poor side while he took another turn with the dull teeth. It's too bad. The other side is nice and sharp, so Tom turns the file over, grasps the handle firmly with his right hand, and puts his right thumb hard upon the file as far toward the center as he can reach. The left forefinger is put under the tip of the file, and the other three fingers support the forefinger. The left thumb is also stretched out toward the middle of the file, and Tom can straighten his bent file by bearing down with thumbs and raising the fingers. It works well for a while. The file is straightened, and cuts fast and well. In ten minutes Tom lays down the file, looks at his thumbs, and says "by jingo," it is hard work. It don't pay to spring a file for every stroke, and Tom soon got sick of it. He took that file to the emery wheel, and beveled each edge of the file to an angle of 60° for about an inch. He bent up two pieces of nail rod, so they would fit on the beveled places like the thread gauge of a slide rest, the pieces came flush with the



HICKS' CLINGSTONE FRUIT PITTING MACHINE

under side of the file and did not project down to be in the way. Tom wound a few turns of wire around the nail-rod clamps; he then squeezed a wedge between wires and and file. It strained up the file just like straining up a buck saw. The lower face of the file was crowing new, and Tom filed away in comfort.

Tom says he is going to make two nice clamps with set screws in one end of each, so he can fit them to any file. He will connect the two clamps with an adjustable rod instead of wire, and replace the wedge with a nice screw with a milled head, and then his "file truss" will look as if a workman made it.

Walker discharged his engineer and hired Ross in his place. Walker's old engineer was a mean rascal, but there are too many like him who call themselves engineers. They are a disgrace to themselves and to all honest men. Walker's rascal (we will not call him engineer any more) worked out a week's notice before he left. When he did go, he left the steam pump stuffed with cotton waste.

Ross came on Monday morning, the thermometer was 'way down "out of sight," (it was in January) and everything was cold and ugly. Ross got up steam in good shape, and when the steam got up to 60 lbs., he tried to start the feed-pump. It would not start worth a cent. He worked and fussed, but to no good. The steam was running up; the water down, and poor Ross wished the job was somewhere else.

Walker came in and helped Ross. No use. The thing was bewitched. Ross banked the fires, took a monkey wrench and yanked off the top of that steam pump. There it was. Cotton-waste in the valves, in the air chamber, in the feed-pipes, stuck in the check valves, caught in every elbow, and hanging to the ends of every piece of pipe. All that feed-pipe had to be taken down and have the cotton-waste dug out of it.

Here is an example for you. Just imagine a man who is entrusted with thousands of dollars' worth of property and many valuable lives, giving vent to such petty spite. Here is an embryo dynamiter for you. Here is a thing too mean to be called a man, much less an engineer. The "dollar-a-day man" is bad enough, but he is to be tolerated in comparison with the outrageous wretch who plugs steam pumps with cotton waste.

There is nothing new about this trick, and more's the pity. Our grandfathers knew all about it, and sometimes knew it to their sorrow when they went to fireman's muster and got beat because their pet engine wouldn't throw 300 feet with a ball of cotton-waste in her pumps.

The electric light men held a convention in New York City recently, which was well attended. Prof. Moses talked about incandescence. He said:

It takes two and a half to three pounds of coal and two inches of carbon an hour per horse-power to run an arc light. The same power will give only one-fifth as much light if used in incandescent lamps. An incandescent lamp costs $1, and can be used a thousand hours. We have solved the problem of lighting the streets by the arc system, and gas has no chance there, but the streets are hardly one-twentieth of the total. The fight is to be carried on in private houses. The future of gas is well defined. With very little outlay, gas companies can make gas with less illuminating and more heating capacity. To heat our houses is the function of gas. There are twenty inches of surface to every gas flame, and the air about is raised to a temperature of 2,000°. The heat is worse than wasted. It raises the temperature of the room and vitiates the atmosphere. An incandescent carbon has a surface of one-quarter of an inch. It is a mechanical problem to reduce that to one-eighth. One horse-power will run twenty incandescent 16 candle-power lamps. We have got as far in arc lighting as we can wish. Our task now is to light up the home, the store and the factory cheaply and well.

Meeting of the Western Railway Club.

At the regular monthly meeting of this club, held in Chicago, August 19, the "Best Method of Lubricating Locomotive Valves and Cylinders," was discussed.

Mr. Sinclair had been connected with the running of locomotives since the time anterior to the use of any methods of lubrication. They managed to get along somehow without oil cups, but it was an expensive way of doing the work. As the valves were increased in size something had to be done, and cups were put on the steam chests.

This was quite an improvement over no cups, but the supply was not regular; it depended upon whether the fireman felt like making frequent excursions to the front end or not. Putting cups in the cab was a further improvement, but he considered this crude. He had repeatedly, in pulling up heavy grades stalled, and backed up and oiled the valves and gone along, showing that a good deal of the power of the engine was used up in moving the dry valves and pistons. He had very little experience with continuous-feed lubricators, but was satisfied that was the direction in which to work. Every increase in size of cylinders and valves is an additional reason for improving the methods of lubrication. As supplementary he thought valves should be balanced, then if steady and sufficient lubrication is provided but little of the power of the locomotive will be absorbed in moving the valves.

Mr. Cook thought that with balanced valves and sight-feed lubricators locomotives would, with the same sized cylinders, do materially more work.

Mr. Stevens said that on their road (Lake Shore) he supposed they had 200 or 250 engines equipped with sight-feed cups. He had found a saving in oil from their use of from six to ten per cent. There was also a saving in the ease with which the engines worked. In reply to an inquiry he said they had no trouble with the sight-feed cups failing to work.

Mr. Verbryck inquired what was found to be the best lubricant for cylinders and valves.

Mr. Cook favored the use of tallow.

Mr. Stevens thought tallow corrosive.

Mr. Sinclair thought attention enough had not been given to overcoming the corrosive effects of tallow. He had had good success with tallow by neutralizing it with carbonate of soda, but it required some knowledge of chemistry. Some of the mineral oils are nearly as good as tallow.

Mr. Tappan thought the acid in tallow could not be removed. The only way he had discovered was by decomposing it, and then you had no lubricant. The Boston & Maine Railroad had spent several thousand dollars in trying to get rid of the acid, and gave it up as a failure.

According to the recent report of the Pennsylvania Bureau of Industrial Statistics wage-workers do not average more than two-thirds time in any but the very best and most prosperous of years; and not one in ten adult males receives wages sufficient to enable them to save against the day of idleness. It is also declared that the wage-workers of Pennsylvania are no worse off than their brothers and sisters in other States of the Union.

The report gives tables of theoretical wages, based upon the rate paid by the day, and tables of actual wages based upon actual working time. Thus the theoretical wages of a puddler in the Western district is $3 50 a day, or $1,092 a year, while the actual wages is only $777 a year. The theoretical wages of a roller is $7.00 a day, $42 a week or $2,184 a year; but his actual wages (average) is $26 a week or $1,554 a year. Common laborers in the mills at $1 25 a day average but $277 a year, instead of $390.

The daily papers have lately recorded the breaking of the backbone of several strikes. Later news from the same sources, however, gives the impression that the vertebræ have a remarkable power of jointing themselves together again.

Duplex Pumping Machinery.

We herewith illustrate a compound duplex pumping engine for water-work service, built by the Deane Steam Pump Co., Holyoke, Mass.

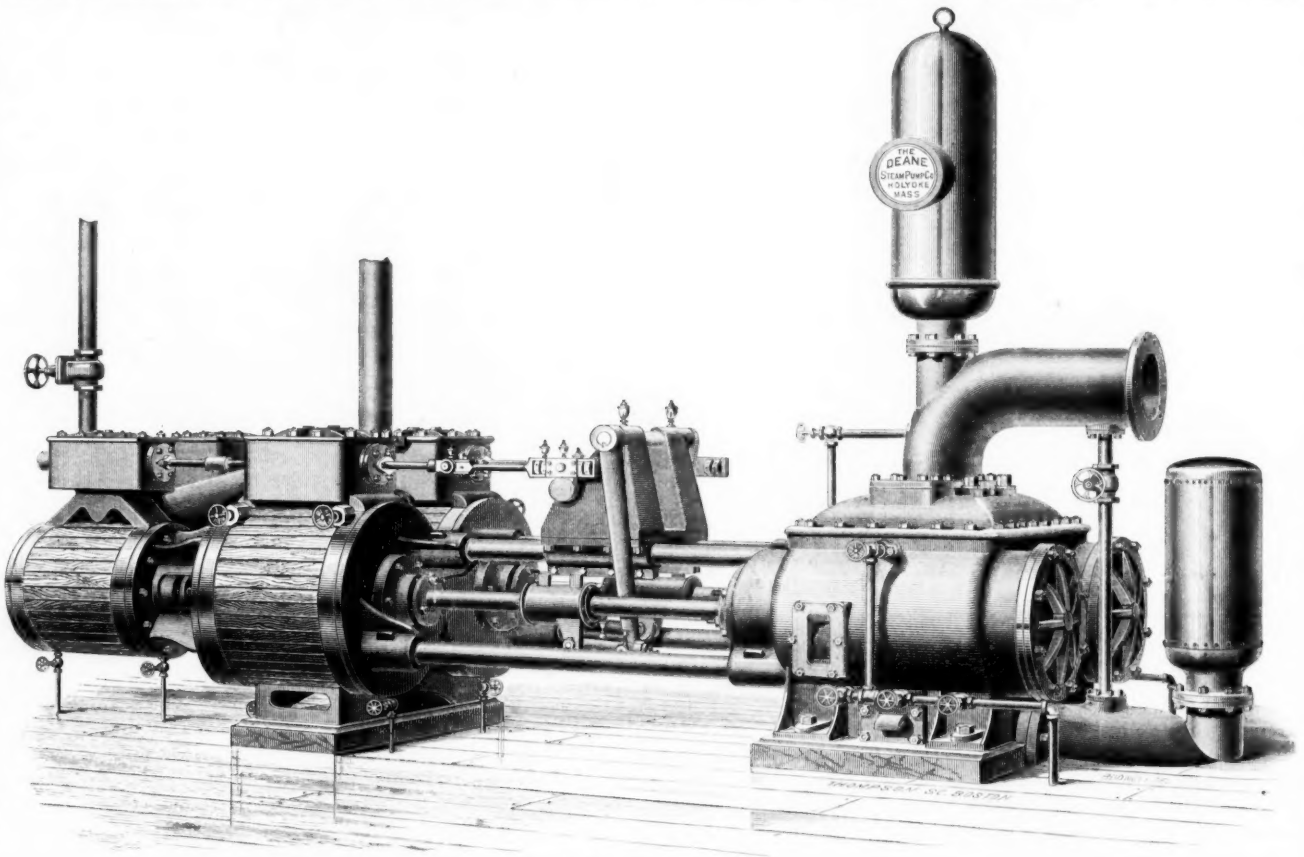
For regular duty in pumping stations an engine is required that possesses a fair combination of cheapness, durability and economy. The one under consideration, by its simple construction, secures the first two elements, and by its compound cylinders, the third.

The cost of buildings and foundations for this class of engines is moderate on account of their compact arrangement.

In direct pumping the speed of these engines may be adjusted to meet the requirements of domestic supply, and the maximum capacity and pressure quickly produced for fire service.

The special features of the duplex compound engine also recommend it for reservoir supply and many other duties in addition to that named.

In the Deane engine the valve motion is adjustable for wear and varying conditions; all stuffing boxes are accessible; the water passages are ample and direct, and the apparatus as a whole is designed for durability and efficiency.



DEANE DUPLEX STEAM PUMP.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS

FIFTEENTH PAPER.

John Brandt is best known to the engineers and master mechanics of the present time as an early master mechanic of the New York and Erie Railroad, in charge of the shops at Piermont, and by the locomotives afterwards built by him at his shops in Paterson, N. J., but little is generally known of the early history of this self-taught inventive mechanic.

My acquaintance with Mr. Brandt dates back to the year 1826; he at that time was carrying on a common jobbing blacksmith shop in Lancaster, Pa.; at the same time my father and elder brother were engaged in manufacturing card clothing for wool and cotton carding machines, also in drawing fine brass and copper wire and weaving wire cloth for facing paper moulds, and for covering paper cylinders, this being about the commencement of the transition from hand to machine-made paper. The business of wire drawing and making paper moulds was commenced by my grandfather, Nathan Sellers, during the early part of the revolutionary war. He was in the service from which he was honorably discharged by special act of Congress in order that he might make moulds for paper making. He was sent under military escort to York, Pa., where, under guard, he made the first pair of paper moulds made on this continent, and on which the paper for congressional use and for printing the continental currency was made.

About the close of the war, the manufactory of hand cards for cotton and wool, and the clothing for carding machines was established in connection with the wire works. The cards were all hand set; that is, the sheets of leather were pierced with holes to receive the wire card teeth on a machine for that purpose. The wire was cut into uniform lengths and formed into the teeth on other machines invented and constructed by my grandfather. I will here note that these machines were so perfect in plan and construction that they continued in use without alteration or improvement for nearly half a century, until superseded by machine set cards. In hand-setting when every tooth had to be separately picked up, and, by nimble fingers, put in the holes pierced to receive them, it gave employment to many hundred children, and often to women, at pick-up work as their aid to bread winning. The work was taken home, and returned when finished. The register of names and residences of those employed exceeded 3,000; the number having work out ranging between 300 and 500.

Some time previous to the time I am writing of, a machine had been invented for doing the entire work, and was in use to some extent, but owing to the shape and largeness of the pierced holes in the leather and consequent looseness of the teeth, had not then supplanted the more costly hand-set.

Early in the year 1826 Mr. James Humes of Lancaster, Pa., who at that time was carrying on a cotton factory, came to us for new clothing for some of his machines, bringing with him a sample of machine-made fillet or ribbon card that had the teeth more firmly set in the leather than the best hand-made. He represented it as the outcome of the brain and workmanship of an ordinary jobbing blacksmith who had never seen any of the machinery then in use for doing any part of the work of card manufacturing.

My father was so well pleased with the sample, that, learning from Mr. Humes that John Brandt, the inventor and maker of the machine, had offered it for sale, he went to Lancaster and found points in the machine of great merit, but it was not constructed in a thoroughly workman-like manner. But as an invention of a man with the few opportunities Brandt had, my father considered it wonderful.

I think it probable that had Brandt seen the machines then in use, he would not have struck on a new track and worked out what he had done, the great merit of which was, so firmly holding and supporting the wire staple tooth that without bending it could be forced through the leather without it being pierced, but not without leading as it passed through the leather and making irregular work, but would with accuracy follow a puncture no larger than the wire, thus the teeth could be as firmly set as required. This he accomplished by so shaping the end of the die or former on which the wire staple was bent by side benders grooved to the size of the wire being used, that as the die was drawn down and out the pusher following the shape of its end, both die and benders being in contact with the leather, there was no possibility of bending the staple as it was thrust home. The second bend or hook of the tooth was then made and the leather moved into position to be pierced to receive the next tooth.

Feeding in the wire, cutting it into proper lengths, seizing and holding to the die, bending into staple, piercing the leather, thrusting in the tooth, drawing out the die as the pusher advanced, making the second bend or hook of the tooth, moving the leather into position for the next tooth, were nine distinct movements, requiring certainty and great accuracy, most of them concentrating to a single point. This first machine he ran at a speed of about 100 teeth per minute, or say, 900 distinct operations.

All these movements he got from cam studs on a brass barrel, not unlike the barrel of a hand organ or musical box. My father explained to him the separate cams on a single shaft that gave all the motions to our old card tooth-making machines, and showed him that steadier and less jerky motions could be got in that way with increased speed than from his short stud cams on his brass barrel. It was proposed that he should go to Philadelphia and see the old card-teeth machines, before commencing others which he had undertaken to make for us. His original machine was purchased, though not expected to be of much use. After making some alterations on it he brought it to the city. When he saw the old machines he was struck with their simplicity, and at once proposed radical changes in making new ones. He asked to be left alone with the old machine that he might study the cams. Soon after this I found him with an old machine taken to pieces. He was busy with his pocket-knife carving out of shingles the forms of the various cams. I offered to make for him drawings of any parts he wanted, and then discovered that he did not understand the simplest plain drawings. His pocket knife was his pencil, and his habit was to carve models out of wood, and to adjust parts by trial, a kind of rule of thumb.

After he had undertaken to build the machines for us, it was decided that my elder brother, Charles, who was a superior worker in metals, should go to Lancaster and remain there working on the new machines with Mr. Brandt. For this purpose he went to Lancaster in 1827. Early in 1828 the first machines were completed, and Mr. Brandt, with his family, removed to Philadelphia, and the firm of Sellers & Brandt, for the manufactory of machine cards, was formed.

It was in the winter of that year while Mr. Brandt, with the assistance of my brother and myself, were engaged in constructing more card machines, he making all the forgings, that he came to me with a proposition. He said no man could be a good working mechanic without being able to make his own forgings, at any rate so far as to forge his own tools and temper them. He proposed to take me as a scholar, if I would, in return, give him some instruction in machine drawing. He went on say, that with proper attention and desire on the part of the apprentice to learn, a few weeks would make a better smith than the customary four or five years' apprenticeship. He said he had given over three years of his life to doing the work of the commonest laborer for what little instruction he got. He proposed that I should be helper, blow and strike for him, for a week; then take the hand hammer, and he would blow and strike for me the next week; that at the end of two or three such terms he would guarantee that I could handle iron and steel as well as he could. There was something so original and novel in his proposition, that I at once acceded to it. The work to be done was mostly light steel forgings and he had enough of his wooden patterns ready for some six or eight weeks' work. The second week, when my turn had come to take the hand-hammer, he handed me a sheet-iron template, giving size and form for a breast-brace of about $3\frac{1}{2}$ in. crank, or swing of 7 in. He wanted me to try my hand at forging one; saying I would always find it a useful tool. With the template he gave me a piece of wire bent to the shape, showing he had marked on it the portions to be forged 8 square, and the round for hand grip; also a wooden model of the socket end. He told me to straighten the wire, and it would help in forging, giving the proper length of each part. Then, to my surprise, he handed me a bar $1\frac{1}{4}''$ square, of charcoal forged hammered iron, to forge a brace whose 8 square portions were but $\frac{1}{2}''$, and the round $\frac{5}{8}''$, and the spindle end about $\frac{3}{8}''$ diameter. I asked why not forge the socket-end drill and square the taper hole for the bits, and weld this to a bar nearer the size? To this he replied that no good smith would drill the socket end, he would punch and work it on a steel mandril; then for the brace no rolled iron will have sufficient stiffness without making it too heavy. This charcoal iron is free from flaws, is the right size, and when drawn down it will have great stiffness. I tried to induce him to take the hand-hammer, but he reminded me that it was my turn, and that I must remember our bargain. If I was afraid to take the "bull by the horns I could never learn how to hold him." Although I expected failure, the brace was forged, and the steel end of spindle successfully welded. This was my first job in that line, and now as I write, that brace lies before me, having stood the service of 57 years, and is as good now as the day it was made. It has always been one of my favorite tools. As I look back over that long period, I can see Brandt as helper doing more towards its production than the head hammerman.

I thought it would be an easy task to make a good mechanical draughtsman of a man

who, with such facility, carved with his pocket-knife the forms he wanted to produce with his hammer, but I was mistaken. He took hold with great earnestness, handled his instruments well, and soon learned to copy line drawings with neatness and accuracy, but it was purely mechanical, for he did not understand the simplest drawings. He said he was often mortified by not being able to understand sketches. A verbal explanation of any portion of a machine was clear to him, but the moment a sketch in illustration was made all was confusion.

It was by mere accident that I discovered his mental difficulty. All his thinking was, if I may so express it, *full size*. The trouble was in reducing to a given scale and carrying both in his mind at the same time. Up to the point of this discovery it would take pages to describe the various devices I resorted to, but now all was plain sailing. By working him on full-size drawings, it was not long before he understood them and became quite proficient.

But some ludicrous things occurred. I will cite but one, premising that he was full of a dry kind of humor, that, at times, was difficult to distinguish from earnest. He showed me a full-size drawing of a crank, made on thin sheet iron and asked me to reduce it to half size. "Why don't you do it?" I asked. "You have two centers on a line." "Yes, I know, and I have done it, but it don't look right. I want you to do it." I did so, and he took it, remarking that it looked too small. I said: "Measure from center to center, and you will find it right." "Yes, but"—and away he walked, and soon came back with both cut out, saying: "I have weighed both. There is something wrong. The half-size does not weigh one-fourth as much as the full-size!"

Tables of areas and superfices only perplexed him. It was evident that the books I gave him to study only confused him. At one time he became very despondent. He said he felt his own ignorance; that he was too old to begin, too old to go to school, but if I could find him a private teacher, that could be trusted and keep his secret, he would make a trial, although over 40 years of age. If he could only be taught how to learn, he thought he could do the rest; but he was sensitive on the subject, and did not want it known that at his time of life he was beginning.

My friend, J. C. Trautwine, at that time in Strickland's office, became much interested in Brandt, and together we consulted Prof. James P. Espy, who had been Mr. Trautwine's mathematical preceptor, who, after an interview or two with Brandt, without his knowing the object, agreed with us that the first step in instruction must be entirely oral. He thought among his pupils he could find a capable one that would devote two or three evenings a week to the work. This was done. Brandt remained in Philadelphia from the fall of 1828 until the spring of 1829. During these months his studies were privately and profitably pursued. In the spring he moved to our card works in Delaware county, but his wife was discontented. They were what is known as Pennsylvania Dutch. In October 1829 the partnership was dissolved, and he returned to Lancaster and resumed his old business of blacksmith.

When, in the fall of 1833, I learned that he had taken the position of foreman of the Pennsylvania Railroad shops at Parksburgh, I went to see him. He then said he was afraid he had given way to the persuasion of Mr. James Cameron, at that time chairman of the board of Canal Commissioners, and feared he would not succeed. I found his office walls covered with working models of eccentrics, rock shafts and steam valves, *all full size*. When I rallied him on adhering to full size, he replied: "It is best, I think, that way." After showing me his models, he called my attention to the exhaust of the English locomotive I had come up on. He said it was all wrong, a 9″ cylinder with only 3″ length of valve ports. It always went by screaming, pish, pish, pish, like boys throwing gravel against a board fence, and he declared that if he ever built an engine, the ports should be at least as long as $\frac{2}{3}$ the diameter of the cylinder. I relate this to show the bent of his thoughts at that early day, He did not prove a failure. He was soon found by other railroad managers, and we next know him as master mechanic of the New York and Erie.

I visited him at Piermont, spending several days with him in the shops and on the road, but have no memorandum to fix the date. He, at that time, showed me his plans for a 10-wheel locomotive, with three pairs of drivers, and a 4-wheel truck, which he had designed for the central or heavy grade division of the Erie Railroad. He had tried without success to get permission to build some at the Piermont shops. He was directed to exhibit his plans and get bids from locomotive builders, and had taken them to Baldwin, who raised many objections, and declined bidding, but the Norris works looked more favorably on his plans. He left his drawings with them, which were returned with their bid. Previous to this he had shown his drawings to Mr. Millholland, of the Reading Railroad, who was enthusiastic, and expressed his opinion that they would be particularly adapted to the heavy coal traffic of the Reading. At the time of my visit he had not got authority to order any for the Erie. He said he understood that Millholland was having a 10-wheeler built by Norris, and he (Brandt) had no doubt it would prove to be the most effective freight engine. He was very particular in calling my attention to the details of his drawings, saying, if I should ever see the Norris engine, he would like me to note how nearly it conformed to his drawings. Some time after this, on meeting Mr. Millholland, I learned that the 10-wheeler was in service, and its performance was even better than he had anticipated. I rode over part of the road with him on the "Susquehanna." In detail the engine differed considerably from Brandt's drawings, as I recollected then, and Millholland remarked, "that after the engine was put on the road some alterations had to be made that would not have been required *had Mr. Brandt's plans been closer adhered to*." I have related the above to award to Mr. Brandt credit he richly deserves as one of the pioneers in advancing the American locomotive to its present perfection.

We next find him located at Paterson, N. J., carrying on locomotive works. The engines he there turned out are known to most of the present master mechanics. At Paterson he and his family were as restless as when at Philadelphia. He sold out and returned to his old home at Lancaster, where he erected shops and started locomotive works, but did not live to see them in successful operation.

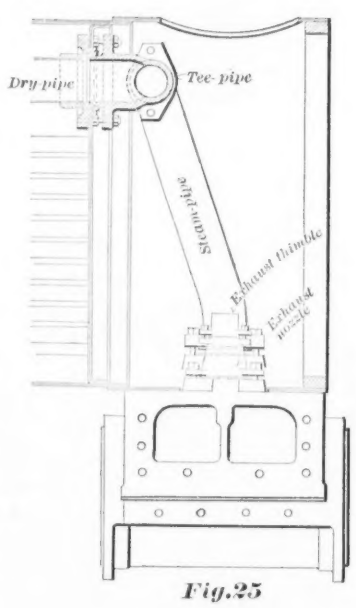


Fig. 25

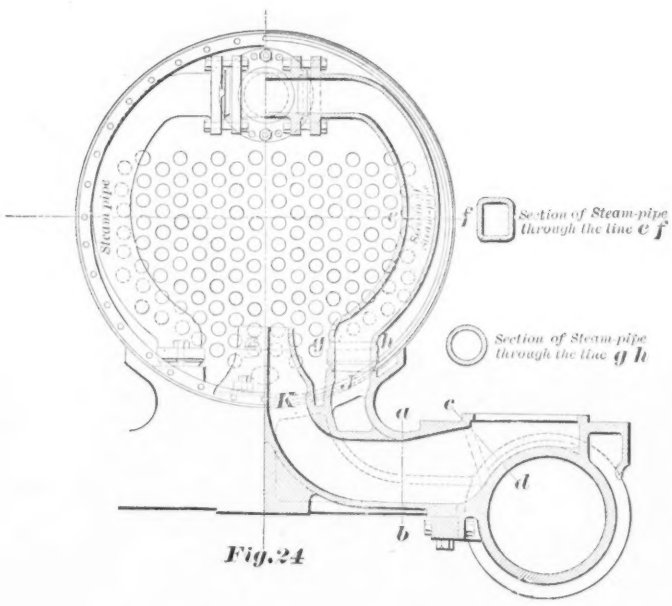


Fig. 24

Modern Locomotive Construction.

By J. G. A. Meyer.

NINTH PAPER.

STEAM PIPES—STEAM AND EXHAUST PASSAGES.

Figs. 24 and 25 show the steam pipes and the manner of connecting these to the cylinders. The steam pipe has only one duty to perform, namely, conducting the steam to the cylinder, and therefore its cross-sectional area is made less than the area of a steam port through which the steam is both admitted and exhausted.

It has been found that for a piston speed of 600 feet per minute good results will be obtained when the cross-section area of the steam pipe is equal to .08 (that is, $\frac{8}{100}$) of the area of the piston; for slower piston speeds proportionally less, and for higher piston speeds proportionally greater. Consequently, to find the cross-sectional area of a steam pipe, we again apply the rule of proportion, thus:

600 : given piston speed :: 0.08 : { steam pipe area in fractional parts of piston area. }

From the foregoing remarks, we can establish—

Rule 7.—Multiply the given piston speed in feet per minute by the decimal .08, and divide the product by 600; the quotient will be the cross-sectional area of the steam pipe in fractional parts of the piston area. Or, writing this rule in the form of a formula, we have—

$$\frac{\left\{\begin{matrix}\text{Given piston speed}\\ \text{per minute}\end{matrix}\right\} \times .08}{600} = \left\{\begin{matrix}\text{steam pipe area in fractional}\\ \text{parts of piston area.}\end{matrix}\right\}$$

Then, multiplying this proportional area by the piston area in square inches, we obtain the number of square inches in the steam pipe area.

Example 10.—Find the cross-sectional steam pipe area suitable for a cylinder 17 inches in diameter, and a piston speed of 500 feet per minute.

According to Rule 7, we have—

$$\frac{500 \times .08}{600} = .0666$$

This means that the steam pipe area must be equivalent to $\frac{666}{10000}$ of the piston area. The area of a piston 17 inches in diameter is 226.98 square inches; therefore, $226.98 \times .0666 = 15.116868$. That is, the cross-sectional steam-pipe area should be $15\frac{1}{8}$ square inches.

With the aid of Rule 7, the following table has been arranged, showing the ratio between the steam-pipe area and the piston area for different speeds.

Using this table when the steam-pipe area is to be found, time and labor will be saved. To find the cross-sectional area of the steam pipe with the aid of this table, we have

Rule 8.—Multiply the area of the piston in square inches by the decimal fraction found in Table 10, on the same line that the given piston speed is indicated; the product will be the number of square inches in the cross-sectional area of the steam pipe.

TABLE 10.

Speed of Piston in Feet Per Minute.	Steam-Pipe Area in Fractional Parts of Piston Area.
200.....	.026
250.....	.033
300.....	.04
350.....	.046
400.....	.053
450.....	.06
500	.066
550.....	.073
600.....	.08
650.....	.086
700.....	.093

Example 11.—Find the steam-pipe area suitable for a cylinder 16 inches in diameter, and a piston speed of 450 feet per minute.

Referring to Table 10, we find on the same line with the given piston speed of 450 feet the decimal .06. The area of a piston 16 inches in diameter is 201 square inches; therefore, $201 \times .06 = 12.06$. That is, the steam-pipe area should contain 12 square inches.

In Fig. 24, the area of the opening *J* of the steam passage should be the same as that of the steam pipe, because the steam passage is a continuation of the steam pipe. Consequently, when we know the area of the steam pipe, we also know the area of the opening *J*, and when we know the area of this opening, its diameter is easily found by referring to a table of areas of circles, or by one of the simple rules of mensuration. From these remarks, we may correctly infer that, for instance, a cylinder 17 inches in diameter and a piston speed of 600 feet per minute will require a larger area in the opening *J* than the same cylinder would require for a piston speed of 500 feet per minute; and, since the piston speed is not the same in all locomotives, we would naturally expect to find a number of core boxes of different size for each cylinder, so that the size of a steam passage could be changed in a cylinder pattern to suit some particular piston speed. To carry out such a system would require too great a variety of patterns; and, to avoid this, master mechanics and manufacturers generally group the cylinders, according to their diameter, into different classes, and adopt for each class some particular diameter for the opening *J*.

In the following table, in column 2 are given the diameters of the openings *J* for the different classes of cylinders, such as are generally adopted; of course, some makers will vary slightly from these figures. In column 3 the diameters of the exhaust opening (marked *K*, Fig. 24) are given. If these exhaust openings are made square, or of some other form, their area should contain about the same number of square inches as the circular openings given in column 3, Table 11.:

TABLE 11.

Column 1.	*Column* 2.	*Column* 3.
Diameter of Cylinders.	Diam. of Steam Opening *J*, in inches.	Diam. of Exhaust Opening *K*, in inches.
10	3	$3\frac{1}{2}$
11	3	$3\frac{1}{2}$
12	$3\frac{1}{2}$	4
13	$3\frac{1}{2}$	4
14	$4\frac{1}{4}$	5
15	$4\frac{1}{4}$	5
16	$4\frac{1}{4}$	5
17	$4\frac{1}{4}$	5
18	$4\frac{1}{4}$	5
19	$4\frac{1}{4}$	5
20	5	5
22	5	5

When an engine is to be designed for a very fast speed, we would advise to determine the area of the opening *J* according to Rule 8, and not follow the diameters given in the last table. The area of any cross-section

of the steam passage should contain the same number of square inches as the opening *J*.

In regard to the exhaust passage, good results will be obtained when the area of any cross-section in the neighborhood of the line *a b* is made larger than the exhaust opening *K*; in fact, we have always obtained good results by making it as large as possible. With large exhaust passages the flow of steam will not be so irregular as when smaller passages are used. In the writer's opinion, large exhaust passages will improve the draft of an engine, and to some extent lessen the back pressure in the cylinder. No rules have been established to determine the area of the exhaust opening *K*. The diameter for these openings, given in Table 11, have been obtained by actual measurements.

Often it will be found that, in designing a locomotive cylinder, the space allotted for the steam passages and exhaust passage in the neighborhood of the line *c d* is very small; therefore, great care and good judgment must be used to obtain the proper cross-sectional area in either passage. The result of carelessness right here will be that either one or the other passage is too small, and the engine will fail to do the work that it was intended it should do.

Steam pipes for locomotives are made of cast iron; their thickness of metal for smaller engines is about $\frac{1}{2}$ of an inch, and for larger engines about $\frac{5}{8}$ of an inch.

On account of some practical difficulties that must be overcome, ordinary flat joints cannot be used between the T pipe and the steam pipe, neither between the steam pipe and cylinder saddle.

The first difficulty that presents itself is the expansion and contraction due to the great change of temperature to which the steam pipes in locomotives are exposed, and therefore we must adopt a joint which possesses a small amount of flexibility.

The second difficulty that presents itself is of a practical nature, namely, the impossibility to construct a boiler and fit the cylinder saddle to the outside of the smoke-box with absolute accuracy, yet a steam pipe of proper length is expected to fit at once in its place, without any more labor than would be required if everything else had been perfectly accurate; hence, the joint must possess a small amount of adjustability.

Adopting a ball joint, the foregoing difficulties can be overcome. These ball joints are made (as shown in Fig. 25) by interposing a brass ring between the T pipe and steam pipe, and another one between the steam pipe and cylinder saddle. Each brass ring has a spherical and a flat surface. Now, it must be readily perceived that with such rings interposed the steam pipe can be slightly moved up or down or sideways, and still maintain a steam-tight joint. This kind of ball joint will also be sufficiently flexible to allow for the contraction and expansion of the steam pipe.

PISTON SPEED.

To determine the piston speed according to the following rule, we must know the speed of train in miles per hour, the diameter of the driving wheels in feet, and the length of stroke in feet:

Rule 9.—To find the piston speed in a locomotive, multiply the number of feet in a mile by the speed of train in miles per hour, divide the product by the circumference in feet of the driving wheel multiplied by 60, and multiply the quotient by twice the length of the stroke in feet; the product will be the piston speed in feet per minute. Or, writing this rule in the shape of a formula, we have—

$$\left\{\begin{matrix}\text{Number of}\\ \text{feet in a mile}\end{matrix}\right\} \times \left\{\begin{matrix}\text{speed of train in}\\ \text{miles per hour}\end{matrix}\right\} \times \frac{\times 60}{\left\{\begin{matrix}\text{circumference of}\\ \text{driving wheel in feet}\end{matrix}\right\}} = \left\{\begin{matrix}\text{twice the length}\\ \text{of stroke in feet}\end{matrix}\right\} = \left\{\begin{matrix}\text{piston speed in}\\ \text{ft. per minute}\end{matrix}\right\}$$

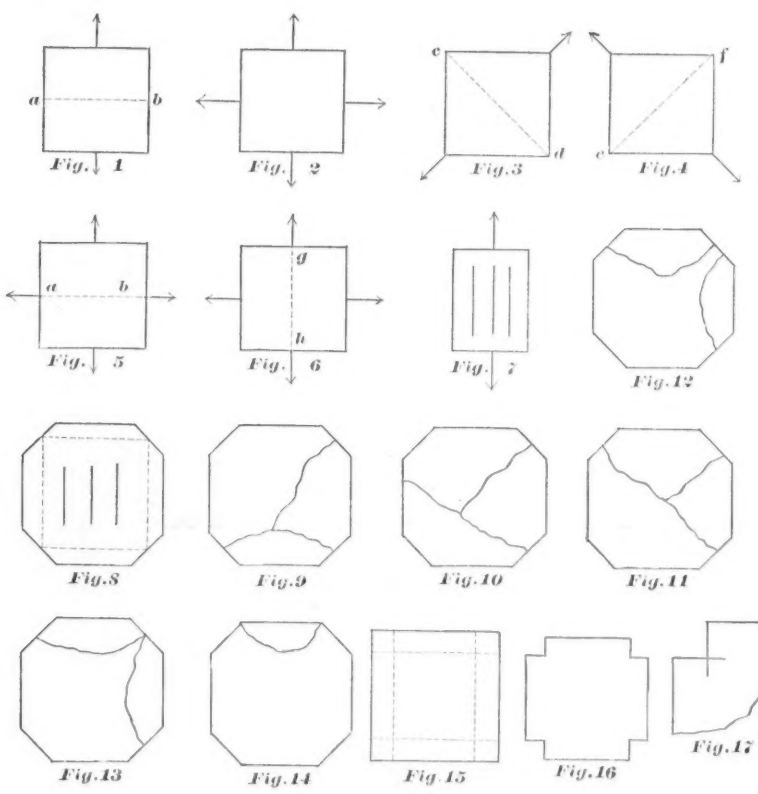
Example 12.—Find the piston speed in feet per minute in a locomotive whose driving wheels are 5 feet in diameter; stroke, 2 feet; and speed of train, 35 miles per hour.

According to Rule 9, we have—

$$\frac{5280 \times 35}{15.7 \times 60} \times 4 = 784\,4$$

That is, the piston speed will be $784\frac{4}{10}$ feet per minute. In order to assist the reader to understand the foregoing rule, the following explanation is offered:

First, we multiply the number of feet in a mile by the speed of train in miles per hour; this product will give the number of feet the locomotive travels in one hour, and, since there are 5,280 feet in a mile, and the speed of train in our example is 35 miles per hour, we have $5{,}280 \times 35 = 184{,}800$ feet that the locomotive travels during one hour. To find the number of feet that the locomotive travels during one minute, we divide the number of feet per hour by 60, because there are 60 minutes in one hour; hence, in our example, $\frac{184800}{60} = 3{,}080$ feet; that is, during one minute the locomotive travels through a distance of 3,080 feet. To find the number of revolutions of the wheel per minute (which is necessary in this case), we divide the distance traveled per minute by the circumference of the driving wheel. In our example, the diameter of the driving wheel is 5 feet; the circumference of such a wheel is 15.7 feet; therefore, $\frac{3080}{15.7} = 196.17$ number of revolutions per minute. During every revolution of the wheel the piston travels through twice the length of the stroke; therefore, multiplying the number of revolutions per minute by twice the length of the stroke, the piston speed per minute will be obtained. In our example, the stroke is 2 feet; therefore, $196.17 \times 4 = 784\frac{4}{10}$ feet. That is, the piston speed is $784\frac{4}{10}$ feet per minute.



LETTERS FROM PRACTICAL MEN.

The Formula for the Bursting Stress of Boilers.

Editor American Machinist:

In a recent number of the AMERICAN MACHINIST Mr. A. F. Nagle, of Chicago, says, in regard to "the generally accepted formula for the bursting stress of the shell of a steam boiler."

$$\left\{\begin{matrix}\text{Bursting}\\ \text{Pressure}\end{matrix}\right\} = \frac{\text{Tensile Strength} \times \text{Thickness}}{\text{Radius.}}$$

"I presume this is generally accepted, but it is not wholly correct. The longitudinal stress is one-half as great as the diametrical, hence the resultant, or actual stress, is represented in direction and amount by the diagonal of a right-angled triangle, whose base is 1 and the vertical $\frac{1}{2}$, and consequent hypothenuse, or diagonal, nearly 1.12. It will then be seen that the ordinary formula gives the strength of a cylinder about 11 per cent. too great."

While admitting the correctness of Mr. Nagle's premises, namely, the longitudinal tension = $\frac{1}{2}$ the diametrical, and the resultant tension = 1.12 times the diametrical, I venture to question his deduction that the material of the shell is thereby exposed to a greater strain *per unit of its cross-section*, and to ask whether he has not overlooked the fact that the resisting section increases equally with the resultant strain.

To simplify the subject, let us suppose a flat square piece of sheet iron, Fig. 1, exposed to a single tension parallel to two of its sides. It resists with the section *a b* = a side. Now, if we add a second tension equal to the first and perpendicular to it, Fig. 2, the effect is the same as if we substituted a single diagonal pull, Figs. 3 or 4, said diagonal pull being = 1.414 times either of the single pulls. But the resisting section *c d* or *e f* is also now = 1.414 times the former resisting section *a b*. Thus the resisting section increases equally with the resultant strain, and the tension *per unit of resisting section* thus remains the same, as does also, of course, the ability of the sheet to resist it, supposing the material to be homogeneous, which is, of course, not quite the case with boiler iron. Whether *c d* or *d f* is to act as the resisting section would doubtless depend upon some slight difference in strength between them. If they were equally strong the fracture might take place on *a b*, Fig. 5, or *g h*, Fig. 6, but in this case the two forces in line with the resisting section would be practically idle, and the problem would again be that of a single pull, as in the first figure.

To illustrate this principle, I recently made some experiments with small strips of thin paper, rather weaker than that on which you print the AMERICAN MACHINIST, and with the following results:

Single pull with the grain, Fig. 7, strips about $1\frac{1}{4}$ inches wide; breaking strain in pounds (19 specimens), 9.5, 11.5, 8.5, 10.5, 11, 11, 11, 10, 9, 9, 9, 8.5, 10.5, 10.5, 12, 11, 11.5, 11, 11; average, 10.3 pounds.

Double pull, Fig. 8, breaking section between clamps, shown by dotted lines, about $1\frac{1}{4}$ inch square. The tension across the grain was kept about 2 lbs. less than that with the grain (20 specimens).

Pull with grain, fractures regular, and as shown in Figs. 9 to 14, from 9 lbs. to $12\frac{1}{2}$ lbs., the average of 20 being 10.8 lbs.

These experiments indicate that the resistance of the (approximate) $1\frac{1}{4}$-inch square of paper between the grips was practically the same with the two tensions as with only one. When the double pull was applied to a full square piece, as Fig. 15, the square corners were found to add greatly to the strength of the piece, the average of six pieces being 12.9 lbs. On the other hand, when these corners were cut out, as in Fig. 16, the strength was considerably reduced (20 specimens averaging only 9.175 lbs.), no doubt because it was impracticable to prevent the scissors from cutting beyond the corner, as in Fig. 17. The beveled corner was therefore used as giving (I thought) the nearest approach to the true strength of the specimen.

JOHN C. TRAUTWINE, JR.

Box Liner.

Editor American Machinist:

To get the liners of a journal box to just the right thickness, is not always such an easy matter as it might seem. Set-screws in the cap make good liners, and are easily adjusted thus: Tighten the cap on to the shaft firmly with the bolts, then put the set screws down firmly, and, next, loosen the bolts just enough to let the shaft fall, and then tighten up on the set-screws all around alike, just taking the strain off the bolts.

F. J. MASTEN.

The Foot of Ten Inches.

Editor American Machinist:

There is no good reason, that I know of, why a foot should contain 12 inches. Big feet are not desirable or fashionable any way. What we need most (for a change) is an American system of measures, equivalent to the Metric system, without change of standards and names, and one that expresses feet and inches decimally, in one set of figures.

This can be easily done by reducing the foot to 10 inches, the inch being the standard and remaining as it is. In that case any number of inches are reduced to feet by the addition of a decimal point. A mile is 63,360″ or 6,336′ or 1,760 yards; a yard becomes 3′ 6″ or 3.6′ or 36″; a meter 3′ 9.3″ or 3.93′ or 39.3″; a rod $5\frac{1}{2}$ yards or 19′ 8″, or 19.8″; a fathom 7′ 2″ or 72″; a square foot 100 square inches; a cubic foot 1,000 cubic inches. Surveyors' measures will not be interfered with. The two-foot rule will be reduced to 20″, and graduated in 10ths, 20ths, &c. It will be much easier to designate a twist drill by decimals than by vulgar tractions, that is, by a large number of 64ths, that nobody understands without a calculation, mental or otherwise. Nearly all steel rules have graduations in 10ths, 100ths, and are familiar to all machinists and all measures under 100 inches ought to be expressed in inches and decimals, the word foot need only be used in larger measures. Mechanics who are not used to 10ths and 100ths will enjoy the change. The only serious difficulty is to indicate which measure is used.

Brazil, Ind. C. W. CRAWFORD.

Using and Marking Twist Drills.

Editor American Machinist:

There is one fault with twist drills that it seems might be done away with or helped. I have reference to the stamping of sizes just exactly where they will be ground off, whenever one of your "don't-care chaps" has occasion to use it. When he puts a drill in the chuck, he does not stop to see whether it runs true or not, starts up the drill, puts on the feed, and then proceeds to put in the balance of the time talking with his next neighbor, or anything else, in fact, that will help pass the time away, oblivious to the fact that his drill is stuck, and the chuck has been spinning around until the shank is all cut up and size figures all erased.

What I wished to say about the size marks on a drill was: Just flatten the shank at or near the end, when the size can be stamped and not be obliterated. I am sure that considerable time would be saved that at present is charged up to profit and loss, in stopping to measure, not one, but seven out of ten that the numbers were ground off the first time they were used.

PASQUIRE.

The Italian Government has a puzzling engineering problem on its hands. Having ordered some 200-ton Krupp guns, it finds that the railroads will not transport them, fearing they will break down the bridges and trestle-work upon which the track is laid. A gun made in sections to screw together would suit the convenience of transportation, but it might not shoot as well as a solid gun.

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NEW YORK, SEPTEMBER 12, 1885.

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Autumn Industrial Exhibitions.

As the time draws near for autumn industrial exhibitions the outlook for their success grows more favorable. Exhibition prospects looked far from bright last spring, but with a noticeable improvement in general business, there is reason to expect fair success with most industrial exhibitions. The Louisville Exposition, already open, has not yet attracted very wide attention. A southern exhibition that begins in the summer, is not likely to draw very large crowds until the advent of cooler weather. The regular annual exposition in Cincinnati promises to contain the usual display of mechanical articles. It is generally well attended, and those who display machinery effect many sales. The St. Louis Exposition also gives promise of success this year; exhibitors are spending money freely in preparing creditable displays. At this exhibition agricultural machinery and tools take a front rank, and the sales are always large. Chicago is putting forth some effort in preparing for their Inter-State Exhibition, especially in securing displays of machinery and tools. Their exhibition building is large, and facilities excellent for a successful fair. In the east, interest centers in the Novelties Exhibition which opens in Philadelphia on the 15th inst. It is a new exhibition, and will have a large display of new articles that will prove interesting. The mechanical feature will be its leading attraction.

In this city the American Institute Fair will open on the 30th inst. The great objection to this fair has been the fact that only a small proportion of the exhibits were new or novel, and that the bazar feature was more prominent than any other. The fair never fails to attract crowds, however, and may be better this year than usual. We have not heard that Boston is to have any exhibition this year.

The North Central, and South American Exposition will open in New Orleans Nov. 10th, and close about April 1st, 1886. It is to be purely an American Exhibition, and the mistakes of the late World's Fair are to be avoided.

Let Convicts Do State Work.

The advocates of the prison contract system, especially those whose interests are closely allied to those of the contractors, refuse to consider or discuss the useful employment of prisoners in any other way than upon private contract, or in manufacturing goods for sale on State account. In other words, they seem determined in their efforts to persuade the public that prison convicts cannot be profitably employed unless their work inflicts some injury upon free labor, and that the contract system produces the most revenue while inflicting no more injury than the "State account" plan of manufacturing. We contend that the State can profitably employ its prisoners without manufacturing anything for sale, and without conflicting with free labor. The State of New York undoubtedly pays out more money every year for work that could be done by convicts, than the whole amount of revenue from prison contracts.

Among the appropriations by the New York State Legislature last June, we notice the followimg:

For completing the wall authorized to be constructed by chapter five hundred and fifty-one of the laws of eighteen hundred and eighty-four along a portion of the bounds of the inclosure of the yard at Clinton prison, the sum of twenty thousand dollars, or so much thereof as may be necessary, to be expended under the direction of the superintendent of State prisons. For the repair of the State road through State lands leading from Clinton prison to Ellenburgh and to the Saranac river, the sum of two thousand dollars to be expended under the direction of the superintendent of State prisons. For rebuilding shops recently destroyed by fire in Auburn prison, nine thousand dollars; and for repairing the coping of the wall around the Asylum for Insane Criminals, two thousand dollars, to be expended under the direction of the superintendent of State prisons. For laying sidewalks and paving gutters in front of State prison lands in the village of Sing Sing, one thousand dollars, to be expended under the direction of the superintendent of State prisons.

We should like to know if there is any reason why the above work could not be done by convicts. The original prison at Sing Sing was built by convicts, and the railroad from Clinton prison to Plattsburgh was built by convicts.

A number of other appropriations were made at the same time for work on other State property that could profitably be done by convicts. It is not the ability, but the inclination, to employ prison convicts with economy on State work that is lacking. The contract system is a bonanza to the few who enjoy its benefits.

John Fink Indicted.

We learn from Detroit that John Fink, whose operations in selling "shop rights" to use a humbug lubricating mixture we have set forth in several issues of the AMERICAN MACHINIST, has been indicted for felony by the Grand Jury of that city. He has humbugged a large number of the best manufacturing establishments in this country out of $100 to $700 each, mainly by showing a big lot of written contracts for shop rights to use his mixture, and a few recommendations, most of which were afterwards renounced by the parties who had written them. He did not make sales through the mails, and had no printed matter to show. He was always in a hurry to catch a train when trying to make another victim, and always closed the contract and collected the money for the same before the buyer had a chance to investigate the merits of the mixture. When it came to a pinch, various misrepresentations were made—usually when no witness besides the individual making the contract could overhear.

Letters from quite a number of prominent firms that have been victimized by Fink have appeared in our columns. The letter from Detroit Machine Screw Company, published in issue of March 22, 1884, shows a clear case of obtaining money under false pretences. This led to the indictment.

It is doubtful whether Fink will be captured. If he leaves the country, he will not go to Canada, as the officers of the law, armed with a *capias*, have been watching for him there. Perhaps he will go to Europe. It is to be hoped, however, that he will be brought to justice.

The Detroit *Evening News* of August 20th says:

Some time ago a distinguished-looking family arrived at a leading Detroit hotel. The lady attracted marked attention from the gorgeousness of her attire. Diamonds as large as peas sparkled in her ears and at her throat. The new guests were said to be immensely wealthy. They occupied the finest rooms in the house, and lived in the most sumptuous style. The head of the family was not a man of intelligent appearance. His signature on the register and his ungrammatical language convinced the proprietors of the hotel that he was a man suddenly thrust into opulence. It was surmised from the wife's magnificent diamonds that the man was a traveling jeweler.

The stranger was busy most of the time. He visited leading manufacturing houses during the day, and received the heads of those concerns at his rooms in the evening. The business men who called were apparently much interested in the stranger. They vaguely hinted that he had in his possession a secret formula which promised to be no less a boon to civilization than electricity and steam. After the stranger had returned from a day's business, he would carry from $500 to $1,000 to the hotel office to be deposited in the safe. It was generally agreed that whoever he was he made money very fast. This is the man against whom the ninth indictment of the grand jury was found, and who will soon be apprehended on a charge of felony.

It is claimed that for several years manufacturing concerns have been swindled by an ingenious patent formula. It was said to accomplish certain valuable results. If the claims had been justified, the patent would have been worth thousands of dollars in saving labor and material. The owner of the formula was the wealthy guest of the leading hotel. The eagerness with which his process was bought is evident from the fact that on one day two Detroit firms paid him $150 each, and another only escaped from paying him $400 by a telegraphic warning that the process was a humbug. A day's business amounting to $700 was not uncommon. As there was no material furnished, the whole amount received was clear profit. Within the last few years the speculator has amassed a fortune amounting to about $300,000.

The successful introducer of the patent formula was well versed in law, and, although his operations had been practiced all over the country, he had never made himself criminally liable. Continued success, however, made him bolder, and his operations finally became so open that a plan for his arrest was organized. When his bargain was made with one Detroit firm, three responsible witnesses were present and accurately noted the entire transaction. The formula was tried, and resulted in ruining several pieces of valuable material. Geo. V. N. Lothrop was consulted at the time, but advised that no arrests should be made until further evidence was accumulated. The Detroit firm had determined to have the speculator apprehended. They notified him that he would be wearing a striped suit in a short time but this threat was laughed at. Evidence was slowly accumulated, and it was finally in such shape that the matter was laid before the grand jury. The chain of circumstances seemed complete in every detail. An indictment was agreed upon. The indicted person has now left town with his family, which will cause some delay and trouble in effecting his arrest.

The next day, Aug. 21, the *Evening News* published the following:

The facts connected with the last indictment of the grand jury are now so well known that there is no longer any need of withholding the name of the accused party. John Fink, of Baltimore, Md., is the wealthy man referred to in yesterday's *News* who is charged with swindling prominent Detroit firms by the sale of a patent formula.

Fink's operations in Detroit commenced on Nov. 28, 1883. He came to Detroit with his family and secured the best rooms at the Russell house. The elegance of Mrs. Fink's attire and jewelry, attracted marked attention. The head of the family introduced himself as the junior member of the firm of Heny Fink & Son, of Baltimore, Md. He laid before the Detroit Machine Screw Works and the Michigan Bolt and Nut Works a patent formula for making lubricating oil. The claims of the patent were very great, but they were apparently justified by many letters of recommendation from business firms throughout the country. The Detroit Machine Screw Company paid $350 for the use of the patent formula, and the Michigan Bolt and Nut Works came down with $150. On trying the patent it is claimed to have ruined a considerable amount of valuable material and to have proved utterly worthless. The Detroit firms thereupon set about to have Fink apprehended. Business houses in different parts of the country who claim to have suffered subscribed from $10 to $50 each to secure Fink's arrest. When the grand jury met the case was laid before them and resulted in the indictment of the wealthy Baltimorean.

Fink has had several years of rich humbugging, but his operations in that line seem to be about ended.

The Toolmaker.

The toolmaker has within the past few years come to be a permanent fixture in most machine shops. The machinist twenty-five years ago was of all mechanics, except, perhaps, the blacksmith, the one who made his own tools. Now, as a natural result of the subdivision of the trade, the toolmaker makes them for him. Notwithstanding a great proportion of the small tools, such as taps and reamers, that were formerly made in the machine shop are now had from the manufacturers who make a specialty of such work, there are still many for peculiar uses that must be made in the shop, while special appliances and fixtures for different jobs are made and used where their use would never have been thought of a few years ago.

One advantage of having a skilled man—that is specially skilled in this kind of work—to make these tools and appliances is, that they are much better made than they were formerly. Not only does the toolmaker acquire special skill in designing and making tools for expediting work, but his tools are a record of his efficiency as a mechanic, and his reputation in this respect stands or falls by their quality. When such tools are made indiscriminately by any one of a shop full of men, no one has much interest in them; their making is looked upon in the sense of a drudgery, to be done without much preparation, and get through with as easily as pos-

sible. Tools made and got together in this way in a shop lacked character, so to speak. Nobody was much interested in studying principles. Making the tools was a secondary matter, for which no one assumed any particular responsibility. The end at which the machinist aimed, and upon which his reputation as a mechanic rested, was something quite different from toolmaking.

Many shops that before the advent of the toolmaker could count up time equal to that of two or three men constantly engaged in making tools, find upon employing a skilled toolmaker, and giving him the necessary machinery to work with, that he not only makes all the tools, but devises special ones for lessening time on many classes of work.

In other than machine shops the toolmaker is of still greater importance; in such businesses as button-making and kindred branches of manufacture, where new designs are constantly demanding new tools, and where the operations *must* be quickly performed, the wages he is able to command are frequently three times as much as those of an ordinary mechanic. But he must be a highly-skilled man. While in one sense the work is not hard, it is exacting, calls for a good deal of thinking, and the ability to think correctly and quickly. If a machinist—a young man—has a decided talent in the direction of devising and making tools, it is worth cultivating; mere copying does not amount to much, but the ability to originate is valuable.

Literary Notes.

PATTERN-MAKING. A Practical Treatise, embracing the main types of engineering construction, and including gearing, both hand and machine made, engine work, sheaves and pulleys, pipes and columns, screws, machine parts, pumps and cocks, the moulding of patterns in loam and green sand, etc., together with the methods of estimating the weight of castings, to which is added an appendix of tables for workshop reference. By a Foreman Patternmaker. With upwards of 370 illustrations. London: Crosby, Lockwood & Co., 7 Stationers' Hall Court, Ludgate Hill.

The author of this work writes very intelligently upon the subject, and from a mechanic's standpoint; the detail with which he treats the subject showing conclusively that he writes from actual experience. It is, perhaps, the most complete of any work of its kind, written, of course, from an English standpoint. American workmen will be inclined to condemn some of the methods and practice, but, on the whole, cannot fail to find much in the book that is instructive. The profuse manner in which illustrative engravings are employed serves to make the text easily understood.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(258) G. C., Indianapolis, Ind., asks: How can I make textile fabrics fireproof, so that a spark will not burn a hole in them? *A.*—A solution of three parts borax and two and one-half parts sulphate of magnesia in twenty parts of water, is recommended for this purpose. We cannot recommend it from experience, but it is easily tried.

(259) F. D., Camden, N. J., writes: Two engines, 7″×10″, are connected to a 3″ shaft. One of the engines is connected by an overhung crank; the other to a center crank, the driving pulley being near and outside the center crank. What should be the size of crank-pin on the center crank? *A.*—The same diameter as shaft will do; it should not be of less diameter.

(260) W. H. D., Leominster, Mass., asks: Suppose I have a bicycle wheel 38 inches diameter, geared up with an endless chain to run the same distance with one revolution of the cranks as a 58-inch wheel with the cranks directly connected. How much more power will it take to drive the small than the large wheel? *A.*—This involves questions in friction which can only be determined by experiment. A fair estimate would be about 25 per cent.

(261) D. W. M., Lynn, Mass., writes: I have a tubular boiler, the tube area of which is 339 square inches. The gases, after leaving the tubes, pass through a brick flue 6 feet long, the area of which is 317 inches, and then through a horizontal pipe 14 feet long, area 254 inches, then into a chimney 50 feet high, area 384 inches. What I wish to know is, if any conditions can be altered to improve the draft? Could not the 14-foot pipe be made larger, or the chimney be made higher, and which would be best? *A.*—Raising the chimney 25 feet would have the most beneficial result, but your connections between flues and chimney, particularly the pipe, are too small. It is not a good plan to reduce the area for the passage of gases below that of the tubes. We should recommend a higher chimney and a larger pipe, inclined upward, if possible, instead of being horizontal.

(262) I. R., asks: 1. By what means is the velocity of water, wind and steam measured? *A.*—The speed of water and steam, under varying conditions, has been measured in different ways; as, for instance, determining the quantity that would pass through pipes in certain times, and from these observations formulas have been constructed for other conditions. The speed of wind is measured by an instrument something like a windmill. 2. How much wood is equal to one ton of good bituminous coal for use under a boiler? *A.*—On an average, about two cords 3. What size of common tubular boiler, size of tubes, etc., would be required to work up to 200 horse-power? *A.*—A boiler 8 feet diameter, 22 feet long, 54 tubes 5″ diameter, should work up to 200 horse-power with a good engine. 4. What would be a fair estimate of good coal used per day of ten hours? *A.*—That would depend upon the kind of engine used. Perhaps 3 tons would be a fair average. 5. How is the crank-pin of an engine tested for being true? *A.*—See "Questions and Answers," July 25. 6. What is the difference between wrought and malleable iron? *A.*—Malleable iron is a species of crude wrought iron. The difference between malleable and wrought iron is in the processes of manufacture. See any dictionary for answers to other questions.

Business Specials

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Katzenstein metallic packing, 169 Christopher st., NY

Air Compressors, Rock Drills. J. Clayton, B'klyn, N.Y.

Curtis Pressure Regulator and St'm Trap, Aug15, p 12

Edw. Sears, wood engraver, 48 Beekman st., N.Y.

Presses & Dies, Ferracute Mach. Co, Bridgeton, N J.

Steel Name Stamps, &c. J.B.Roney, Lynn, Mass.

Treatise on gear teeth and bevel gears; specimen pp. free. Geo. B. Grant, 66 Beverly st., Boston, Mass

Universal grinders for lathe-centers, chucks, angles, or cylinders. C.C.Hill, 84 Market st., Chicago, Ill.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John st., N. Y.

Improved Labor-Saving Upright Drills; prices reasonable. Currier & Snyder, Worcester, Mass.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Foot-Power Machinery for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to lay out gear teeth. Price, 50c. E. Lyman, C. E., New Haven, Conn.

Lathe tools, improved threading tools, cutting-off tools. Catalogue sent. H'tf'd Tool Co., Hartford, Ct.

Drop presses, and other special tools, manufactured by Williams, White & Co, Moline, Ill.

Selden Packing for stuffing box, with or without rubber core Randolph Brandt, 38 Cortlandt st., N.Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

Farley's Reference Directory of the Machinists', Iron, Steel and Metal-Working trades of the United States. A. C. Farley & Co., Philadelphia, Pa.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co, Collinsville, Conn.

The outline ("wax process") engravings shown in the AM. MACHINIST each week are made by Struthers, Servoss & Co., 24 to 34 New Chambers St., N.Y.

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-Taught;" $4. Books for workmen. Joshua Rose, Box 3306, New York City.

Patent Bolt Dogs, as illustrated in AM. MACHINIST of Sept. 5, sent prepaid anywhere in the U. S. upon receipt of $2.25. Fay & Scott, Dexter, Maine.

Morrison's Practical Engineer, a complete treatise on steam and general machinery. Price, $1; mailed free Indicators, Engineers' Instruments and outfits. W. A. Morrison, Box 373, Lowell, Mass.

Locomotive Engine Running and Management. By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air brake explained by aid of engravings. Price, $2. For sale by *National Car Builder*, 187 Dearborn st., Chicago, Ill.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

Manufactures

Chas. Coerper & Co., Chicago, will erect a $24,000 brewery.

W. S. Johns proposes to start a machine shop at Nashville, Tenn.

The Sheffield Iron Works, Sheffield, Ala., will establish a foundry and machine shop.

Heintz & Munchow, Buffalo, N. Y., will erect a four-story brick factory, to cost $15,000.

J. D. Larkin & Co., Buffalo, N. Y., will erect a five-story brick factory, to cost $13,000.

Galveston, Texas, is about to build a system of water-works to supply the city with fresh water.

S. Liebman's Sons, brewers, Brooklyn, N. Y., will erect a $15,000 building for machinery and storage.

The Wylie Foundry and Machine Co., of Toronto, Ohio, are erecting a large shop for building engines.

Dwight Slate, Hartford, Conn., has taken the agency for the sale of W. R. Fox's universal trimmer.

Bids are invited by the Board of Managers for an electrical railway on the exposition grounds, New Orleans, La.

It is said that the car shops of the Texas Pacific Railroad, now at Marshall, Texas, are to be removed to Dallas.

The Quitman (Ga.) Cotton Mills, which originally cost over $40,000, were recently sold for $7,000 to C. Groover & Co.

Wilson, Walker & Co. (Limited), Pittsburgh, Pa., will erect an addition to their works for the manufacture of coal cars.

The Birmingham (Ala.) Stove Co., have commenced work on their buildings; the main buildings will be 140x200, and 100x150 feet.

W. R. McClory, Pittsburgh, Pa., will erect large flint glass works near Pittsburgh at once. Estimated cost, $250,000. Will employ 300 hands.

The Weed Sewing Machine Co., Hartford, Conn., has reduced its capital stock from $600,000 to $240,000, and the par value of a share from $25 to $10.

One hundred and fifty employes of the Michigan Bolt and Nut Works, at Detroit, recently went out on a strike against a 10 per cent. reduction of wages.

The Pond Engineering Co., St. Louis, have been awarded the contract to furnish the entire pumping machinery plant for the Mexico, Mo., waterworks.

Atlanta, Ga., is about to increase her water supply. The pumps will be run by turbine wheels in the Chattahoochee river, seven miles distant from the city.

Messrs. Rittenhouse, iron founders and machinists, of East Main street, Norristown, Pa., are preparing to finish their new foundry during the present year.

The roundhouse and repair shops of the Providence and Springfield R. R., at Providence, R. I. have been destroyed by fire. Estimated loss, $15,000 to $20,000.

T. Carlin's Sons, Allegheny City, Pa., will erect a boiler shop this fall on North avenue, to be operated in connection with their machine shops on Anderson street.

Warren Spears of Aurora, Ill., has erected a building for the purpose of manufacturing machinery and making repairs. Steam power will be used. Capital, $7,000.

The Sheldon Axle Works, of Auburn, N. Y., will probably locate in Wilkesbarre, Pa., the $100,000 capital stock which they tried to place as a condition having been taken.

The Duffy Malt Whiskey Co., of Baltimore, will establish extensive bottling works, in which it is claimed that they will invest about $200,000. Considerable machinery will be put in.

The Mount Vernon shops of the Northern Central Railway Co. at Baltimore are to be lighted by electricity, and they are putting in a Ball automatic engine to supply the necessary power.

L. Katzenstein & Co., 169 Christopher street, New York, have been advised by their agent in England that their metallic packing has received the highest award at the Inventors' Exhibition in London.

Cleveland, Brown & Co., of Cleveland, Ohio, have made Mayor Davis and Silas Harford, of Niles, a proposition to run the old Ward rolling mill in the interest of the town. The proposition has been accepted.

The new Washington Steel Works, at Reading, Pa., have just been completed. Walter M. Stein, Thomas E. White, and R. C. Borchers, of Philadelphia, are the proprietors. The chief product will be steel castings.

A company from Lansdale, Pa., will erect a foundry at West Point, Pa., and do the casting for the West Point Engine and Machine Company. For further information address the West Point Engine and Machine Co.

It is proposed by English capitalists to form the Talladega Iron Co., at Talladega, Ala., to purchase mines containing 2,000 acres, and erect two blast furnaces; the capital stock to be $250,000. George W. Chambers, of Talladega, is now in Europe working up the scheme.—*Baltimore Manufacturers' Record.*

The North Star Iron Works Co., Minneapolis, Minn., write us: "Our works are running night and day two crews of men. We are very busy, with best prospects ahead. Are making many improvements and adding new tools.

The Worcester Steel Works, Worcester, Mass., have a contract to make 200 tons of a new pattern of street railway rail recently patented by President C. A. Richards and Roadmaster Elizur Barnes, of the Metropolitan Railroad, Boston.

Taunton, Mass., is to be asked to contribute $50,000 as an inducement to a Connecticut silverware and cutlery company to transfer its business to that city. The business is wanted, and the money will probably be forthcoming.—*Manufacturers' Gazette.*

The C. A. Treat Manufacturing Company, of Hannibal, Mo, formerly doing business under the title of C. A. Treat, has been incorporated to manufacture railway and machine supplies. Capital stock, $15,000. Corporators, C. A. Treat, J. W. Treat, W. E. Treat, and G. B. Treat.

A company has been organized for the purpose of establishing a new pipe mill at Scottdale, Pa., H. C. Overholt, secretary and treasurer; Wm. Smith, general superintendent. The mill will have a capacity of forty tons per day, which may be increased to eighty tons, if trade justifies it.

Ellis & Lessig, of Pottstown, Pa., have informed their heaters, helpers, rollers, and others working about the rolls in their mills, that their wages will be increased, the increase, in some cases, reaching as much as 20 per cent., with the prospect of the mill going on double time, and plenty of work.

The Sweetland Chuck Co., of New Haven, Conn., which failed and was expected to pay 25 cents on the dollar, is paying 60 cents instead. The special tools, patent and material of the Sweetland chuck have been sold to the Hoggson & Pettis Mfg. Co., who will manufacture the chuck hereafter. Mr. Sweetland has gone into their employ.

The cotton factory property at Athol has been bought for $27,000 by Mr. Allen, owner of the Wendell Pulp Works, who will proceed to arrange in the two smaller buildings the machinery needful for the manufacture of the pulp. The main building will eventually be used for making either pulp or paper. It has a valuable water-power.

The St Louis *Age of Steel* says: "Business at local machine shops has undergone some improvement in the last month or six weeks, particularly at the larger establishments. Some of the small shops, however, are still very lightly employed. The machine works at the foot of Chouteau avenue are running with about two-thirds of a full force.

The McDonald Machine Co., recently organized in Portland, Me., has contracted with the Portland Company to build an engine on the plan of the the company's new patent, and it will be ready for trial in about a month. The new principle is also to be applied to several small tools, notably the screw-driver and ratchet drill, and arrangements to manufacture these are now being made. The stockholders believe they have a rich property in their patents.—*Industrial Journal.*

The Dubuque and Northwestern Railway Company has bought about 50 acres of land in the northern part of the city of Dubuque, Ia., for machine shops, transfer grounds, and other uses. The final course of the road has been decided upon, and it will be pushed forward with all possible speed. Its destination is a point about 160 miles northwest of Dubuque and 20 miles northeast of Austin, Minn., where it will connect with the Stickney road from Mona to St. Paul. It will cross the Southern Minnesota and the Chicago, Milwaukee and St. Paul in its course. The engineers are locating the line northwest of Dubuque, and right of way is being acquired in Northern Iowa and Southern Minnesota.

The Knowles Steam Pump Works, 93 Liberty st., New York, and 44 Washington st., Boston, have issued a new illustrated catalogue in handy form for use. Among the specialties represented we notice a portable boiler and steam pump on wheels, a stationary fire apparatus, compound condensing mining pumps, sinking pumps, artesian well pumps, condensers for steam engines, combined air and circulating pumps for surface condensers, vertical wrecking pumps, vacuum pumps for sugar vacuum pans, hydraulic pressure pumps, duplex steam and power pumps, and compound condensing duplex engines for water-works. The last five pages of the catalogue give useful information and tables of value to engineers and others.

The Eclipse Wind Engine Company, of Beloit, Wis., have shipped of late a carload of machinery to each of the following places: St. Louis, Mo.; Kansas City, Mo.; Lincoln, Neb.; Denver, Col.; San Antonio, Tex.; St. Paul, Minn. They also sent one 16-foot geared mill to the West Indies; one 16-foot pumping mill to St. Petersburg, Russia; six 16-foot, six 12-foot, and six 14-foot mills to Sidney, Australia; six 4″×12″ pumps to Fort Scott, Kansas; two 25-foot pumping mills, two 5″×16″ double-acting pumps, and ten 2½″ underground pumps to Boston, Mass.; three 14′×18′ water tanks to Zionsville, Ind.; two 12′×16′, one 12′×12′, and three 9′×10′ water tanks to Cheyenne, W. T.; one 12′×14′ tank, and twenty-five 8′×9′ tanks to Memphis, Tenn. All the space in their foundry is occupied, and they are melting on an average 10,000 to 12,000 pounds of iron per day. All the other departments are running full handed. Mr. G. E. Wheeler, the former superintendent, has lately been placed in charge of the books in the main office, and Mr. Hardy, who formerly had charge of the shipping department, has been appointed superintendent.

Machinists' Supplies and Iron.

NEW YORK, Aug. 27, 1885.

The supply business and iron trade industries improve, but do not show any radical change.

Iron—The market for American pig shows but very little improvement. Inquiries from consumers looking towards replenishing stocks are a little more numerous, but the volume of business remains about the same. In Western markets, consumers are buying a little more freely. The opinion prevails there that bottom prices have been reached. We quote Standard Lehigh brands No. 1 Foundry at tidewater, $17.50 to $18; No. 2. $15 50 to $16; Grey Forge, at furnace, $13 50 to $14.50.

Copper—The demand continues moderate, with quotations of 11⅛c. to 11¼c. for Lake, and 10¼c. to 10¾c. for other brands a little less is bid by buyers.

Lead—The market is easier, with 4.20c. asked, but buyers bidding less.

Antimony—Hallett's 9c.; Cookson's 9½c.

Spelter—Refined, 4.75c. to 5c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Situation as foundry supt. or foreman. Best reference. Address Founder, AM. MACHINIST.

Mech. engineer and draftsman, of long experience, well recommended, wants a situation. R. G., 448 E. 58th street, New York.

Chilled plow man, with long experience, and can work colored labor in foundry, is open for engagement. Address Plows, AM. MACHINIST.

Wanted—A practical foreman for a pipe foundry; one having some capital to invest preferred. Address Pipe Foundry, AM. MACHINIST.

Machinist desires position in some progressive or wide-awake toolroom.; correspondence solicited. Address Box 379, Waynesboro, Franklin Co., Pa.

Wanted—Situation by graduate C. E.; is rapid and accurate draftsman; understands machinery thoroughly. Best refs. Address A., Wilkesbarre, Pa.

Boilermaker desires situation as foreman of boiler shop; has had 15 years' experience as foreman; best references. Address B. S. F., AM. MACHINIST.

Wanted—Situation as foreman of foundry, by a man at present holding the same position; distance no object; can refer to past and present employers. Address foreman, AM. MACHINIST.

Wanted—Position as manager, superintendent or designer, by mechanical engineer, who has had many years' experience on hoisting, pumping and stationary engines, air compressors, mining machinery and refrigerating machines; best references Address BOX 9, AM. MACHINIST.

Wanted—Situation by an engineer of twelve years' practical experience on large condensing engines; thoroughly familiar with the indicator and other modern instruments; been over 5 years with present employers in one of the largest and best mills in the country; United States license, and good references; steamboat preferred. Address O. N. F., AM. MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Crescent Steel Tube Scraper is king. Crescent Mfg. Co., Cleveland, Ohio.

To make room for larger tool, will sell cheap, for cash, a planer 42"x42"x12', in good order. Address P. O. Box 2085, Bridgeport, Conn.

For Sale—28"×16' engine lathe, 36" planer, 60" pulley lathe, 3 small lathes, 28"×24' shafting lathe, 3 drill presses. A. G. Brooks, 261 N. 3d st., Phila., Pa.

Experimental machinery built; details worked out; shortest notice; reasonable terms. Pennington & Mills, 8 Dey st., Jersey City Heights, N J.

Wanted—Responsible parties selling to steam users, or dealing in mill supplies, to handle several first class articles new and easy to sell. Address Kelley & Downing, Erie, Pa.

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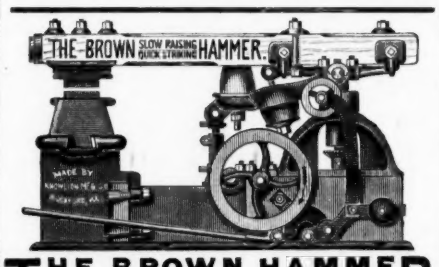

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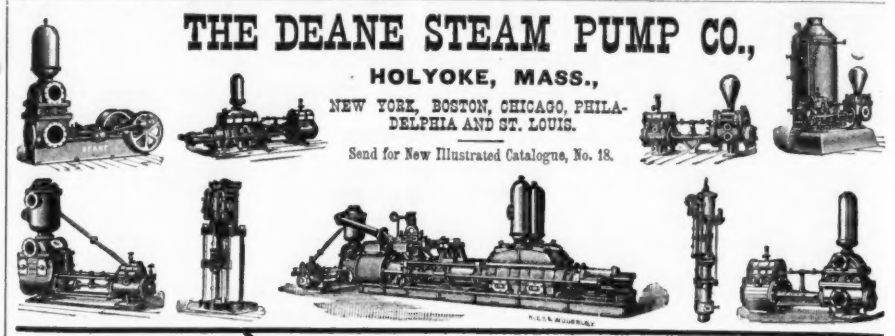

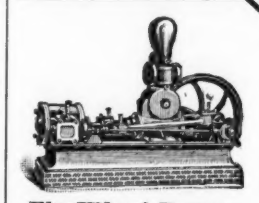

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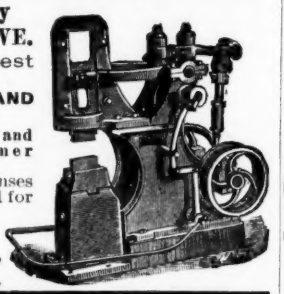

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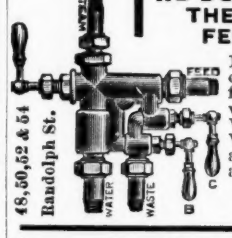

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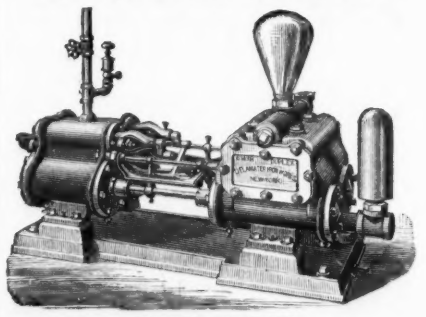

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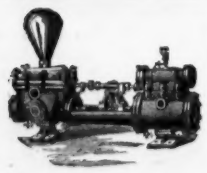

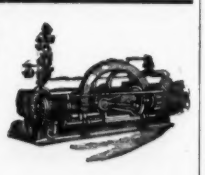

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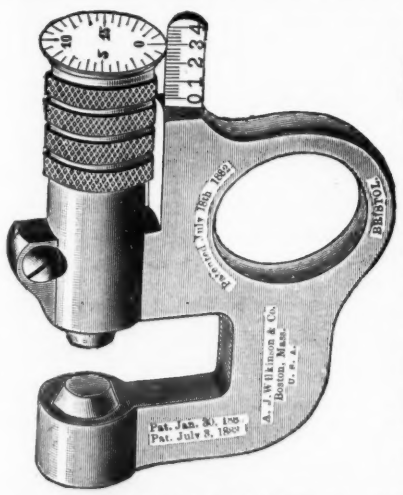

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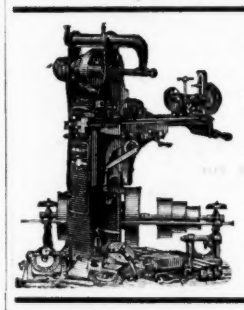

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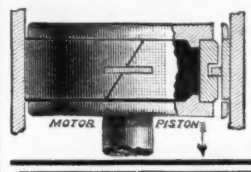

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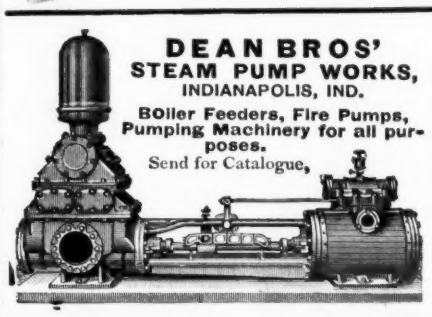

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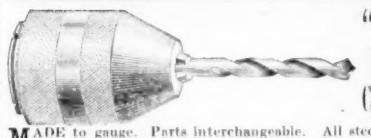

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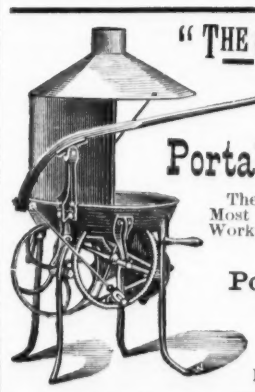

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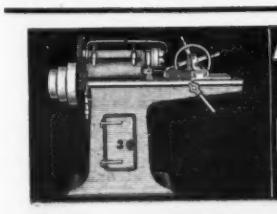

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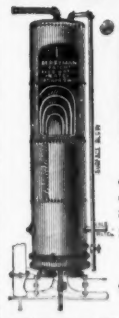

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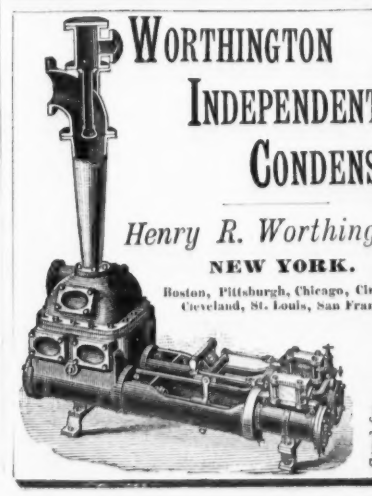

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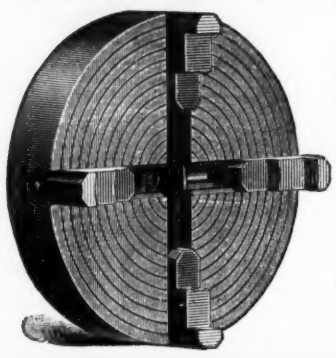
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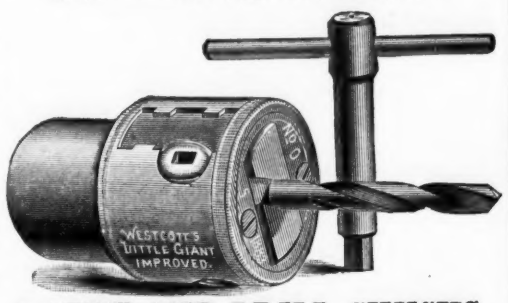

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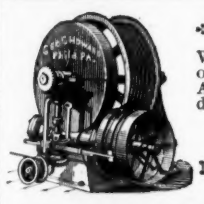
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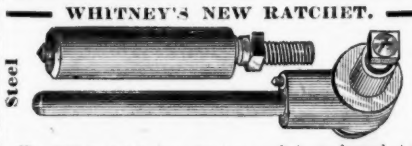
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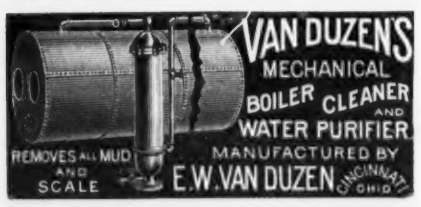

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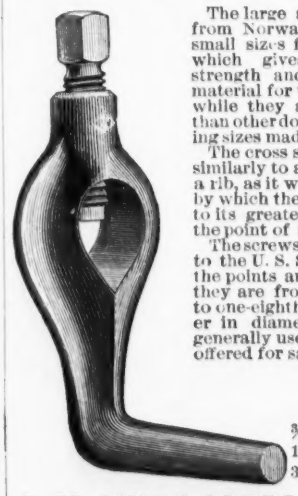
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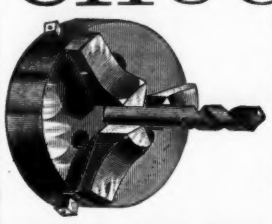
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NOTICE.

Week before last we published, under this heading, references to a small portion of the practical articles that have been specially prepared for the AMERICAN MACHINIST, and have appeared in our columns during the last few months. Last week we published an additional list. We append another list below. No other mechanical journal in this country has or ever has had such a collection of practical articles, by writers of well known ability, as are presented in these columns week by week. Every issue gives information that is taken up and applied in the shops and factories in various parts of the country. Copies containing these articles can be readily obtained by ordering of any newsdealer, or by writing to this office, at 5 cents per copy.

F. G. Woodward.
A Primitive Electro-Magnet Engine. Aug. 22, 1885
Car Transit by Endless Cable. Feb. 28, 1885.
How to Clean Foul Pipes. Dec. 6, 1884.
How to Originate a Scale of Equal Parts. Sept. 6, 1884.

Wm. H. Harrison.
The Development of the Connecting Rod. Sept. 5, 1885.
Balancing Revolving Bodies. March 21, 1885.

John A. Caldwell.
Blue Lines on White Ground. May 2, 1885.

Geo. B. Grant.
Pitch of Worm Gears. May 23, 1885.

J. A. Hill.
Oiling Locomotive Valve Motion. May 23, June 27, 1885.

Benj. F. Hetherington.
Casting Rolls on a Shaft. May 23, 1885.
Cleaning Boiler Tubes. June 14, 1884.
Boiler Makers and Boiler Buyers' Methods. April 25, 1885.

Wm. Hultgran.
Foundry Foremen's Blunders. Jan. 24, 1885.
Shrinkage of Castings. May 23, 1885.

W. W. Hanscom.
Cable Railway Transit. July 26, 1884; March 28, 1885

John Snow.
Reducing the Face of Spur Gears in the Mould. Feb. 28, 1885.

Geo. O. Vair.
Moulding Potash Kettles in Green Sand. Feb. 14, 1885.
Cutting Down the Face of Gear Wheels in the Mould. Nov. 15, 1884.

C. A. Smith.
Balancing Revolving Bodies. Feb. 7, 1885.
The Bourdon Pressure-Gauge Tube. Jan. 31, 1885

F. G. Jahn.
A Method of Nickel Plating. Aug. 16, 1884.

John Coffin.
The Balance of Rotary Parts of Machinery. Jan. 17, May 16, 1885.

Wm. J. Williams.
Piston-Rod and Valve-Stem Packing. April 25, 1885

W. E. Crane.
The Use of Zinc in Boilers. July 5, 1884.
Cylinder Oils — Economical Size for Engines. April 25, 1885.
Another Way to Pack a Piston-Rod. April 11, 1885
Bridge Walls and Latent Heat. March 22, 1884.

Geo. R. Stetson.
Reasons for the Variation in Tapers of Morse Twist-Drill Shanks. April 4, 1885.

M. W. Sewall.
Machine-Shop Floors. Dec. 6, 1884.

James W. See.
The Safety Element. Nov. 1, 1884.

C. E. Lipe.
Milling Machine Cutters for Double Duty. June 28, 1884.

David Spence.
Charging Cupolas. April 5, 1884
Tinning Wrought Iron. June 20, 1885

A. H. Mathesius.
Power Needed in Operating the Cable Road on Brooklyn Bridge. January 3, 1885

Jno. C. Trautwine, Jr.
What Is Centrifugal Force? April 5, 1884
Centrifugal Force, a Component of Tangential Tendency. April 26, 1884
Nature of Centrifugal Force. May 17, 1884

A. B. Landis.
Counterbore and Facing Bar. July 25, 1885.
Tinning and Babbitting on Cast Iron. August 1, 1885.

T. H. Radcliff.
On the Warping and Cracking of Castings. July 18, 1885.

R. D. Wade, Supt. Motive Power Richmond & Danville R. R.
Richmond & Danville R. R. Co.'s Cast-Iron Smoke Stack. August 1, 1885.

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Grinding Drills. August 1, 1885.

Ed. F. Williams.
Inertia of the Reciprocating Parts of the Steam Engine. September 13, 1884
Inertia in its Nature and Means of Measurement. August 23, 1884
Inertia Diagram. October 18, November 1 and 22, 1884; January 3, 1885

C. C. Collins.
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W. Barnet Le Van.
The Trouble with the Philadelphia Traction Co.'s Road. March 28, 1885.
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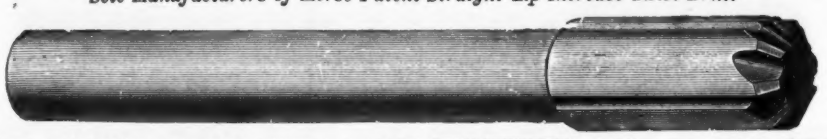

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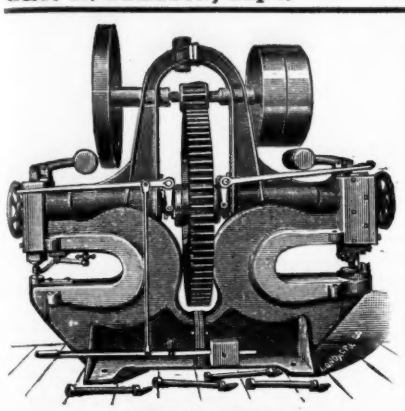

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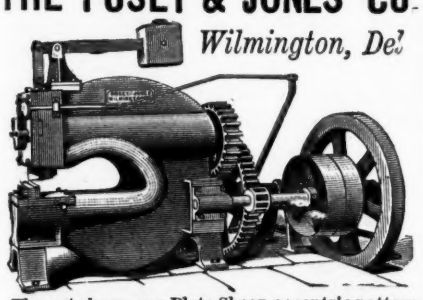

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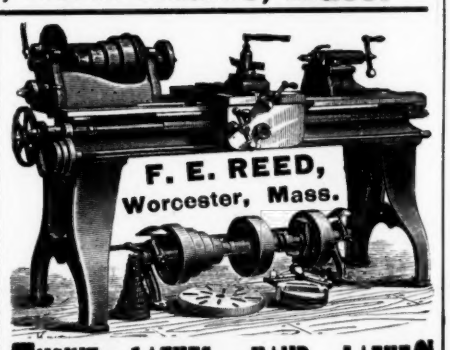

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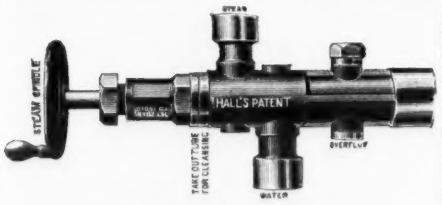

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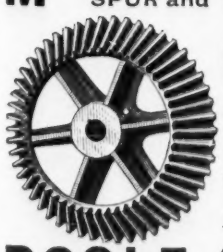

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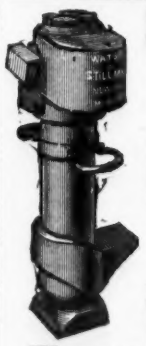

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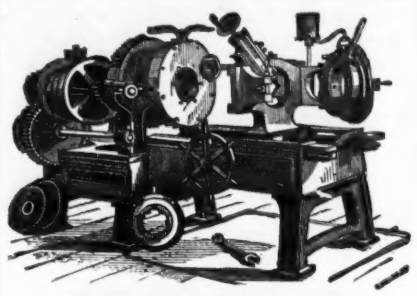

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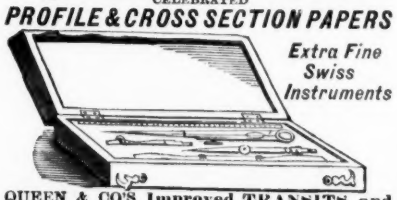

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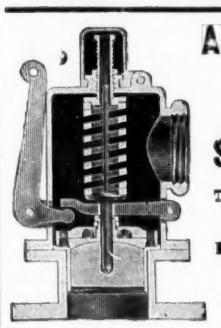

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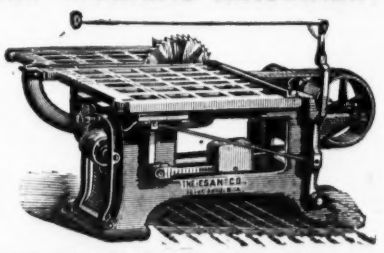

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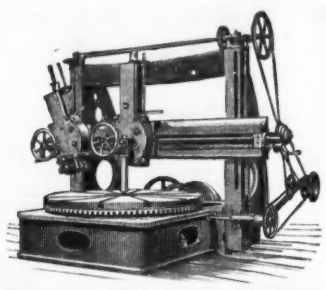

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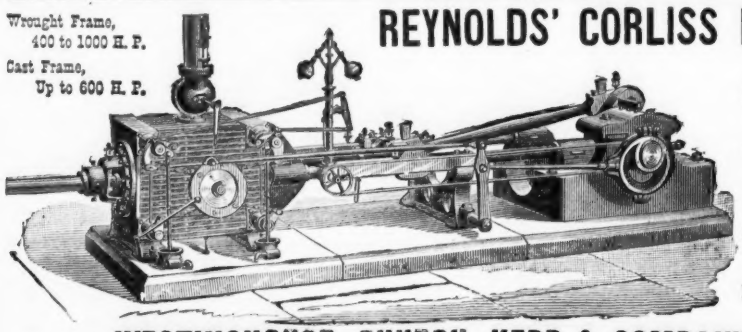

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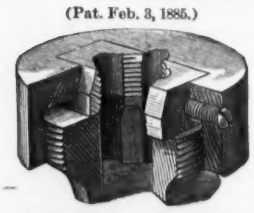

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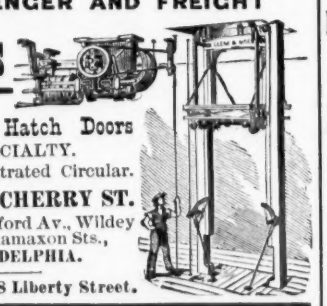

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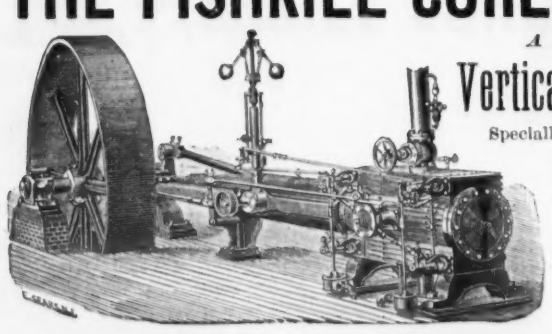

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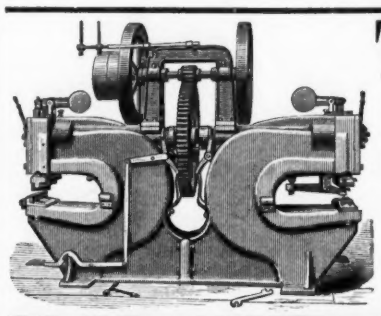

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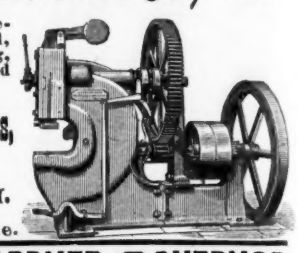

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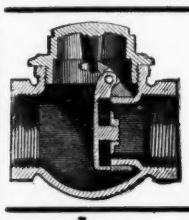

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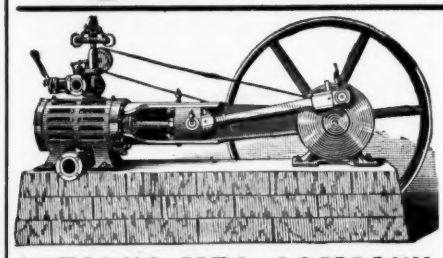

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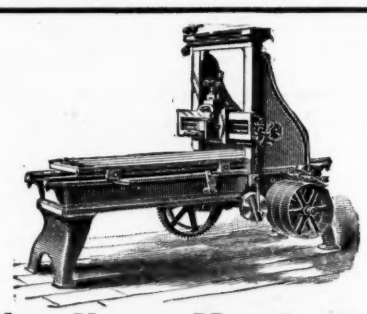

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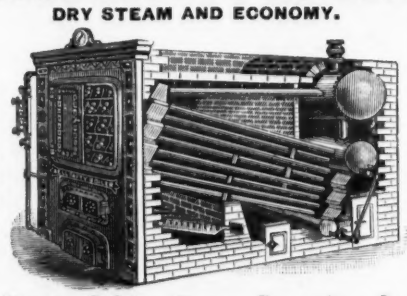

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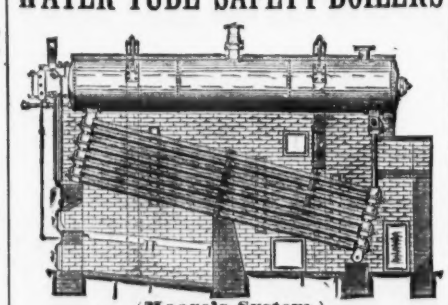

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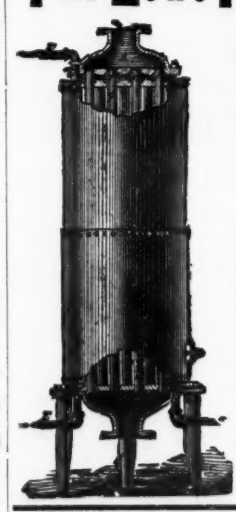

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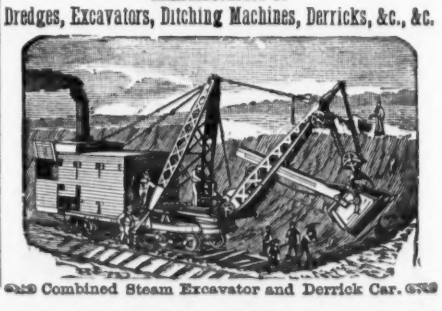

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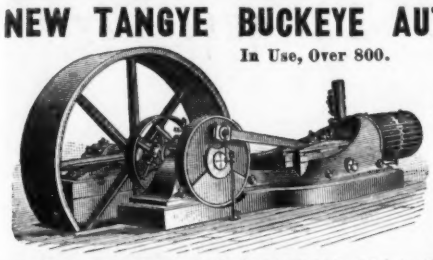

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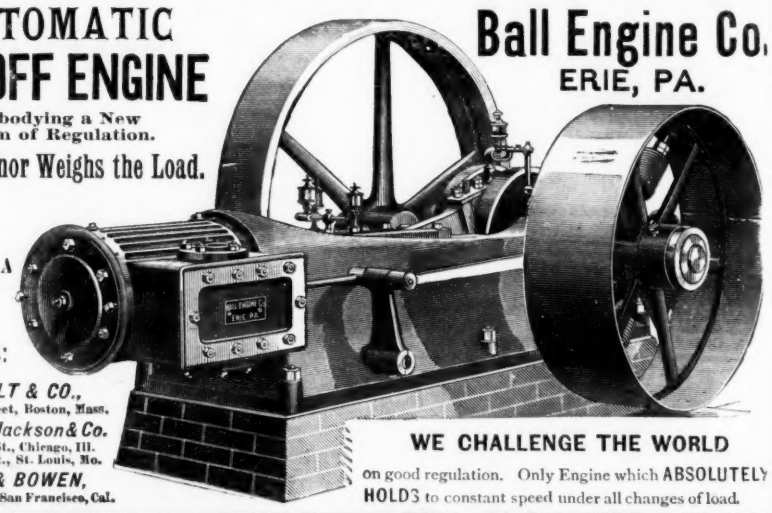

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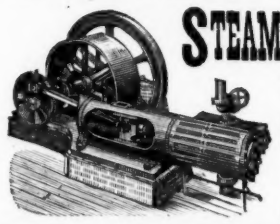

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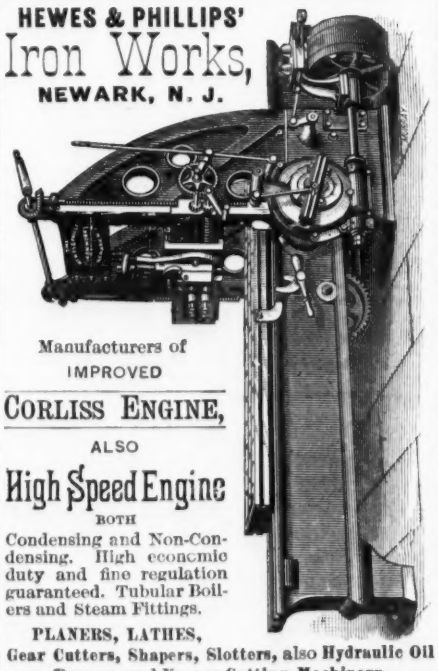

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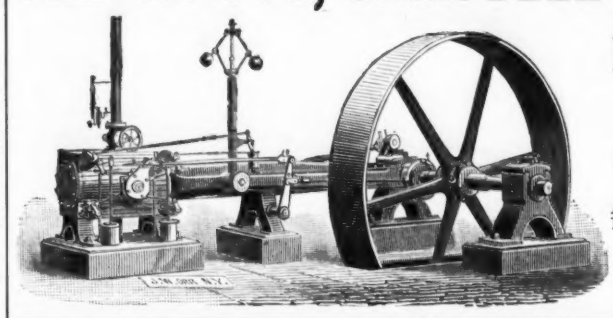

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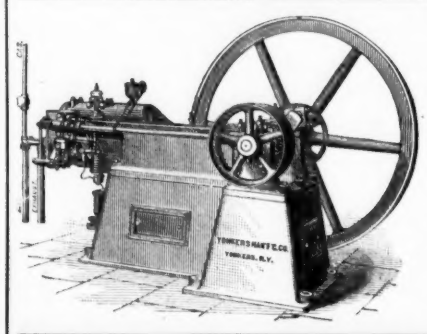

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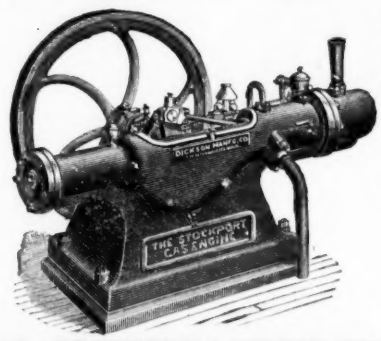

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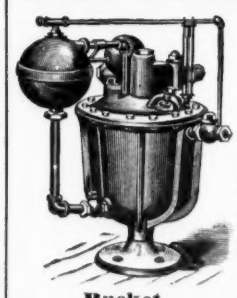

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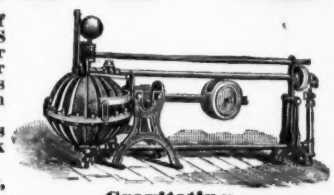

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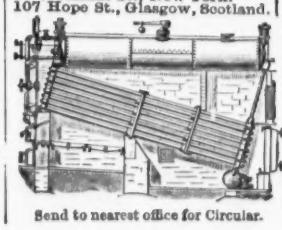

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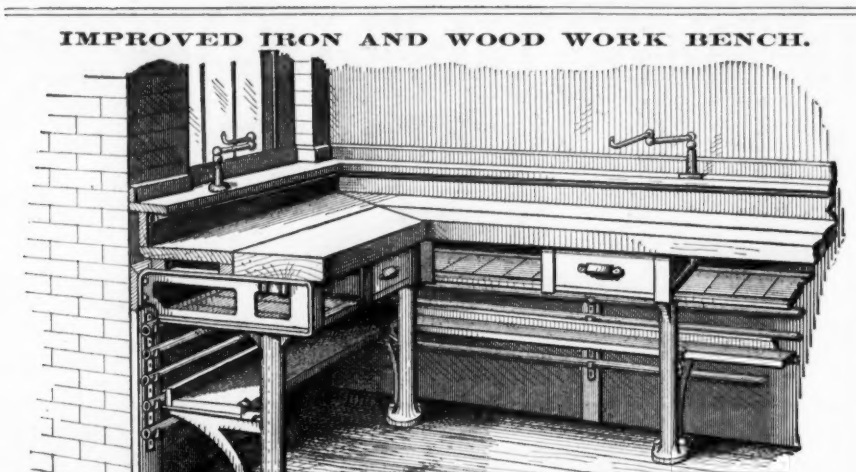

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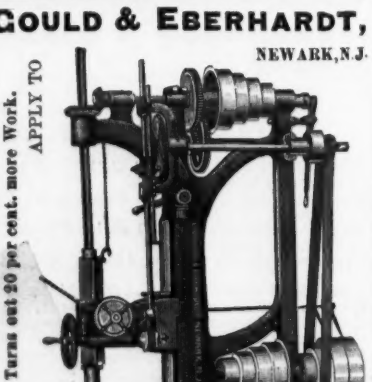

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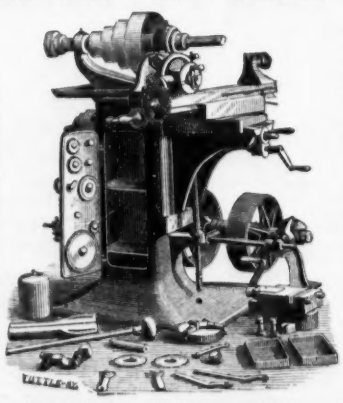

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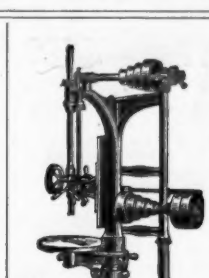

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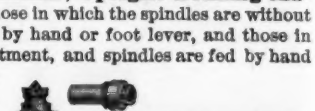

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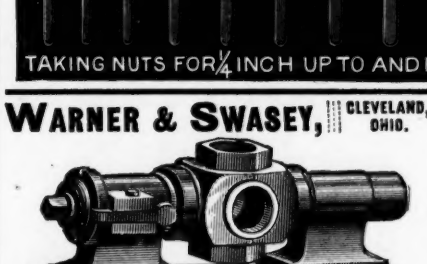

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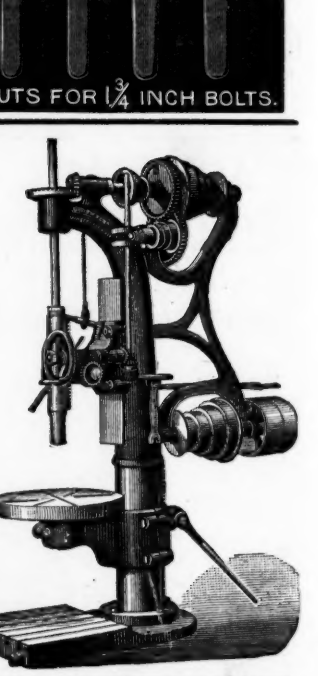

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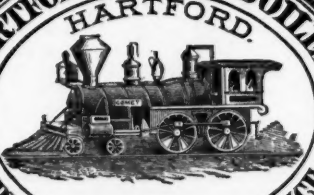

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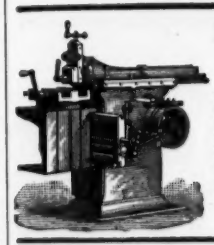

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